PB 204 383

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
Springfield, Va. 22151

BIBLIOGRAPHIC DATA SHEET	1. Report No. APTD-0791	2.	3. Recipient's Accession No.

4. Title and Subtitle
Air Pollutant Emission Inventory for the State of Montana

5. Report Date
September 30, 1971

6.

7. Author(s)
Robert A. Ewing and Janet K. Baker

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201 (Franklin County)

10. Project/Task/Work Unit No.
No. 2

11. Contract/Grant No.
68-02-0040

12. Sponsoring Organization Name and Address
Environmental Protection Agency
Office of Air Programs
Research Triangle Park, North Carolina 27711

13. Type of Report & Period Covered

14.

15. Supplementary Notes DISCLAIMER - This report was furnished to the Office of Air Programs by Battelle, Columbus Laboratories, 505 King Avenue, Columbus, Ohio 43201 in fulfillment of Contract 68-02-0040

16. Abstracts - This report estimates the annual emission of the five principal air pollutants (particulates, SO_2, carbon monoxide, hydrocarbons, and NO_2) in the State of Montana, as of 1970. The data were obtained from voluntary responses to questionnaires sent out in behalf of the state, supplemented by published references on fuel usage and area emissions, and by personal communications. Point source losses are responsible for nearly all of the SO_2 emitted in the State. Principal sources of SO_2 emissions are, naturally, nonferrous metal smelters followed by oil refineries and utilities; the balance is acoounted for mostly by the industrial combustion of fuel. The same group of point sources accounts for about one-third of particulate emissions. Additional substantial contributers are forestry and agricultural operations, including teepee burners and slash burning, contributing about one-third, and forest wildfires and stubble burning, estimated to contribute about one-fourth.

17. Key Words and Document Analysis. 17a. Descriptors

- Air pollution
- Emission
- Inventories
- Particles
- Sulfur dioxide
- Carbon monoxide
- Hydrocarbons
- Nitrogen dioxide
- Combustion products
- Industrial wastes
- Agricultural wastes
- Automobiles
- Smelters
- Refineries

17b. Identifiers/Open-Ended Terms

- Montana
- Particulates
- Air quality control regions

17c. COSATI Field/Group 13B

18. Availability Statement Unlimited

19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 94
20. Security Class (This Page UNCLASSIFIED	22. Price

FORM NTIS-35 (10-70)

USCOMM-DC

C

AIR POLLUTANT EMISSION INVENTORY FOR THE STATE OF MONTANA

to

ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF AIR PROGRAMS

Contract No. 68-02-0040
Task Order No. 2

by

Robert A. Ewing and Janet K. Baker

September 30, 1971

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201
Franklin County

EXECUTIVE SUMMARY

This report estimates the annual emission of the five principal air pollutants (particulates, SO_2 carbon monoxide, hydrocarbons, and NO_2) in the State of Montana, as of 1970. The data were obtained from voluntary responses to questionnaires sent out in behalf of the state, supplemented by various published references on fuel usage and area emissions, plus numerous personal communications from a number of knowledgable Montanans. The emission inventory contained in this report will satisfy the inventory requirements of the Implementation Plan which Montana is required to formulate and submit to the Environmental Protection Agency.

Point-source process losses are responsible for nearly all of the SO_2 emitted in the State (~90%). Principal sources of SO_2 emissions are, naturally, nonferrous metal smelters (~85%) followed by oil refineries and utilities, each with ~3%; the balance is accounted for mostly by the industrial combustion of fuel.

The same group of point sources accounts for about one-third of particulate emissions. Additional substantial contributors are forestry and agricultural operations, including teepee burners and slash burning, estimated to contribute about one-third, and forest wildfires and stubble burning, estimated to contribute about one-fourth.

Particulates and SO_2 are point-source pollutants, and hence, are primarily industrial problems. The individual consumer and homeowner is responsible for very little of the emissions of either of these. However, as an automobile operator, the individual citizen is responsible for most of the emissions of the other three pollutants; CO, HC, and NO_2. Some of all three of these come, of course, from other operations, such as slash burning, stubble burning, wildfires, and the industrial combustion of fuel. Although the proposed Federal regulations on automotive emissions should realize significant reductions in these three pollutants, controls on slash burning may be required to achieve desired air quality standards for these pollutants.

TABLE OF CONTENTS

Page

INTRODUCTION 1

DESCRIPTION OF TASK 4

METHODOLOGY--INVENTORY TECHNIQUES AND ASSUMPTIONS 9

- Point Sources 9
  - Data Acquisition 9
  - Data Treatment 11
- Area Sources 16
  - Bases for Apportioning 17
  - Fuel Apportioning - Coal 18
  - Fuel Apportioning - Oil 26
  - Fuel Apportioning - Gas 28
  - Fuel Apportioning - Railroads 29
  - Open Burning 31
  - Solvent Evaporation 32
  - Motor Vehicles and Gasoline Marketing 32
  - Grain Elevators 34
  - Asphalt Batching Plants 36
  - Aircraft 37
  - Slash Burning 37
  - Agricultural Burning 42

RESULTS 44

- Summary of Fuel Use and Emissions by Region 45
- Summary of Fuel Use and Emissions for Hot-Spot Areas 52

TABLE OF CONTENTS
(continued)

Page

Urban Population of Hot-Spot Counties 52

Summary of Aircraft Traffic and Emissions 61

Summary of Vehicular Traffic 61

REFERENCES 64

APPENDIX A

PERTINENT MONTANA AIR POLLUTION REGULATIONS A-1

APPENDIX B

CALCULATION OF ALLOWABLE PARTICULATE EMISSIONS FROM WOOD WASTE BURNERS B-1

APPENDIX C

EXPLANATION OF MONTANA EMISSION INVENTORY COMPUTER PRINTOUTS C-1

LIST OF TABLES

Table 1. Jurisdictions Included Within Air Quality Control Regions 7

Table 2. Relationship Between Production of Lumber and Waste. . . 13

Table 3. Population of Counties: 1970 and 1960 17

Table 4. Population of Places: 1970 and 1960. 18

Table 5. General Statistics for Standard Metropolitan Statistical Areas, Counties, and Selected Cities: 1967 and 1963. . . 24

Table 6. Retail Establishments, By County. 25

Table 7. Montana 1970 Motor Vehicle Registration 33

Table 8. State and National Forest Acreage, Montana, By County, 1970 39

TABLE OF CONTENTS
(continued)

Page

Table 9. Emissions Inventory Summary - Billings AQCR 46

Table 10. Emissions Inventory Summary - Great Falls AQCR 47

Table 11. Emissions Inventory Summary - Helena AQCR 48

Table 12. Emissions Inventory Summary - Miles City AQCR 49

Table 13. Emissions Inventory Summary - Missoula AQCR 50

Table 14. Comparison of Pollutant Emissions for Montana Air Quality Control Regions 51

Table 15. Emissions Inventory Summary - Billings-Laurel Area . . 53

Table 16. Emissions Inventory Summary - Great Falls Area 54

Table 17. Emissions Inventory Summary - Anaconda Area 55

Table 18. Emissions Inventory Summary - Butte Area 56

Table 19. Emissions Inventory Summary - Helene-East Helena Area . 57

Table 20. Emissions Inventory Summary - Missoula Area 58

Table 21. Emissions Inventory Summary - Kalispell-Whitefish- Columbia Falls Area 59 59

Table 22. Emissions Inventory Summary - Libby-Troy Area 60

Table 23. Annual Aircraft Traffic By Types At Selected Airfields in Montana 62

Table 24. Annual Emissions from Montana Aircraft Traffic 63

LIST OF FIGURES

Figure 1. Air Quality Control Regions of Montana 5

Figure 2. Location of "Hot-Spot" Areas in Montana 7

Figure 3. Generalized Emission Inventory Questionnaire 10

Figure 4. Railroads in Montana 30

Figure A-1. Maximum Allowable Sulfur Emissions-Nonferrous Smelters A-9

Figure C-1. Point Source Data Form C-2

Figure C-2. Area Source Data Form C-5

INTRODUCTION

This report describes the Montana air pollutant emission inventory conducted in the spring of 1971. The inventory is based primarily upon calendar 1970 data; for some nationally-gathered statistics it was occasionally necessary to use 1969 or 1967 data, principally to determine apportioning factors.

The report covers the state of Montana, some 147,138 square miles, with a 1970 population of 694,400 persons.

> "Fourth largest state in the Nation, Montana is divided into two sections by the main range of the Rocky Mountains. The eastern or plains section, occupying about three-fifths of the total area, consists of an undulating tableland broken frequently by stream valleys and by branches of the Rockies or isolated groups of mountains. From the eastern boundary to the backbone of the continent, the land gradually rises in elevation from 2,800 feet to 4,000 or 5,000 feet in the foothills of the Rockies. The western portion of the state is rugged, cut by several mountain ranges and interspersed with picturesque valleys.
>
> The state is basically agricultural. Hard winter wheat, the major crop, is grown on the upland plateaus and plains in the central and eastern areas. The valleys of both the mountainous and prairie sections produce diversified crops, such as sugar beets and beans. Corn and hay are grown to feed the great beef herds. The income from cattle and sheep raising is a major contribution to the state's economy.
>
> One of the state's greatest natural resources is its forest land; the lumbering and wood products industry is currently the fastest growing area of economic activity. Wood products include items such as boxes, sash and doors, paper pulp, plywood and prefabricated buildings.
>
> Mining was responsible for Montana's first boom in the 1860's and is still important. Fifty-eight different minerals are now being recovered: chiefly copper, silver, gold, lead, zinc, petroleum, manganese, natural gas, coal, phosphate and chromite. Oil wells and coal mines dot eastern Montana, while the western part is noted for metal mining."(1)*

---

* References at end of report.

Though vast in area, Montana is a thinly populated state; 694,400 persons in the 147,138 square miles, less than 5 persons per square mile. There are some 500 communities in the state, but only 100 have over 100 persons; and there are but 5 with populations exceeding 20,000. It is, therefore, not unexpected that Montana's pollution problems are primarily point-source related rather than population-density related. It is also not surprising that an emission inventory does not point up the same types of problems found in the more densely populated and more industrialized states of the eastern United States. For example, smog from automobile vehicles is not the serious problem it is in many states. Similarly, smog from stationary fuel combustion is not much of a problem. Except for a very few central power generating stations, coal is hardly used either industrially or domestically. Natural gas dominates the fuel picture in Montana, supplemented by some oil.

Control over pollution in Montana is the responsibility of the Air Pollution Control Division of the State Board of Health, located in Helena, the state capital. This Division is actively pursuing the improvement of air quality in Montana, and has made considerable progress in inducing improvements in pollutant emissions from major point sources, especially since passage of the Montana "Clean Air Act" of 1967. Indicative are the following paragraphs from the December 31, 1970, report on the "Status of Air Pollution Control in Montana".

> "With the passage of the Clean Air Act of Montana which became effective on July 1, 1967, a six year abatement plan was developed which should, by June 30, 1973, find all major and significant air pollution sources in Montana under control except slash burning. Slash burning on forest lands presents the largest technical problem not yet entirely resolved. While the curtailment, if not the complete elimination, of slash burning is currently only a goal to be achieved by June, 1973, it is expected that the regulations which now make slash burning acceptable will be revised so that such burning will be in violation of the open burning regulations.

> "Annual revisions are made to the regulations or more frequently, if necessary, as information is developed on the control procedures available, the severity of the problem, and the demands of the people. On June 30, 1973, it is expected that at least 75% control will have been achieved with the remaining 25% not under positive control due to circumvention, lack of adequate local participation, pollution originating outside the state and that contributed by automobiles, dust from plowed fields, wild fires and slash burning."(2)

The required emission inventory of air pollutants in Montana is but one part of a similar nationwide effort, all leading to an implementation of the Federal Clean Air Amendments of 1970. Battelle Memorial Institute, Columbus, Ohio, under contract to the Environmental Protection Agency, was engaged to assist Montana in the preparation of such an inventory.

The general procedure for the emission survey is based upon the "Air Pollutant Emission Inventory Techniques" described by Bierbaum and Gedgaudas(3) for estimating air pollutant emissions and using the emission factors compiled by McGraw and Duprey(4). As in all such surveys the results presented are estimates, and should not be interpreted as absolute values. In some cases emission factors were unavailable, and in others estimates of production or consumption data were necessary. In spite of these limitations, the overall inventory is of sufficient accuracy to be used for Montana's implementation planning.

DESCRIPTION OF TASK

Basically, the task was "to define total emissions and sources of air pollution within the state of Montana, with respect to the following air pollutants, and above the indicated emission levels:

Pollutants	Tons/yr
Particulates	5
SO_x	10
CO	25
Hydrocarbons	25
NO_x	25

Air pollutants other than these five were considered beyond the scope of this inventory, and were not included, although some of the major ones were noted by comments.

Information on point sources were obtained by voluntary responses to questionnaires sent out by Battelle-Columbus in the name of the State. These were supplemented by various published references on fuel usage and area emissions, plus personal communications from a considerable number of persons, whose assistance materially aided the compilation of this inventory.

The entire U. S. has been divided by the Environmental Protection Agency into "Air Quality Control Regions (AQCR's), of which there are five in Montana. None include any large metropolitan areas which overlap state boundaries, as frequently occurs in the eastern U. S.; all five are totally within the State. The five, outlined in Figure 1, and listed below, are all large in area, as evidenced by the fact that it requires three Universal Transverse Mercator (UTM) zones to span Montana:

EPA AQCR No.	Principal City	Regional Population	Area, acres	No. of Point Sources
140	Billings	135,263	16,406,746	110
141	Great Falls	144,070	15,406,080	78
142	Helena	167,100	18,184,750	110
143	Miles City	93,221	30,692,387	39
144	Missoula	154,691	12,399,360	83
		694,345	93,089,323	420

The counties in the AQCR's are identified in the calculations and tabular results throughout the report as indicated by Table 1.

In addition to the inventory by region, pollutant emissions were also to be summarized for the eight "hot-spot" areas in the State, in which the major point source pollutant sources were concentrated. There were three of these "hot-spot" areas in the Helena region (Anaconda, Butte, and Helena-E. Helena); three in the Missoula region (Kalispell, Libby, and Missoula); one in the Billings region (Billings-Laurel); one in the Great Falls region (Great Falls); and none in the Miles City region. Locations of these areas are shown in Figure 2.

NOT REPRODUCIBLE

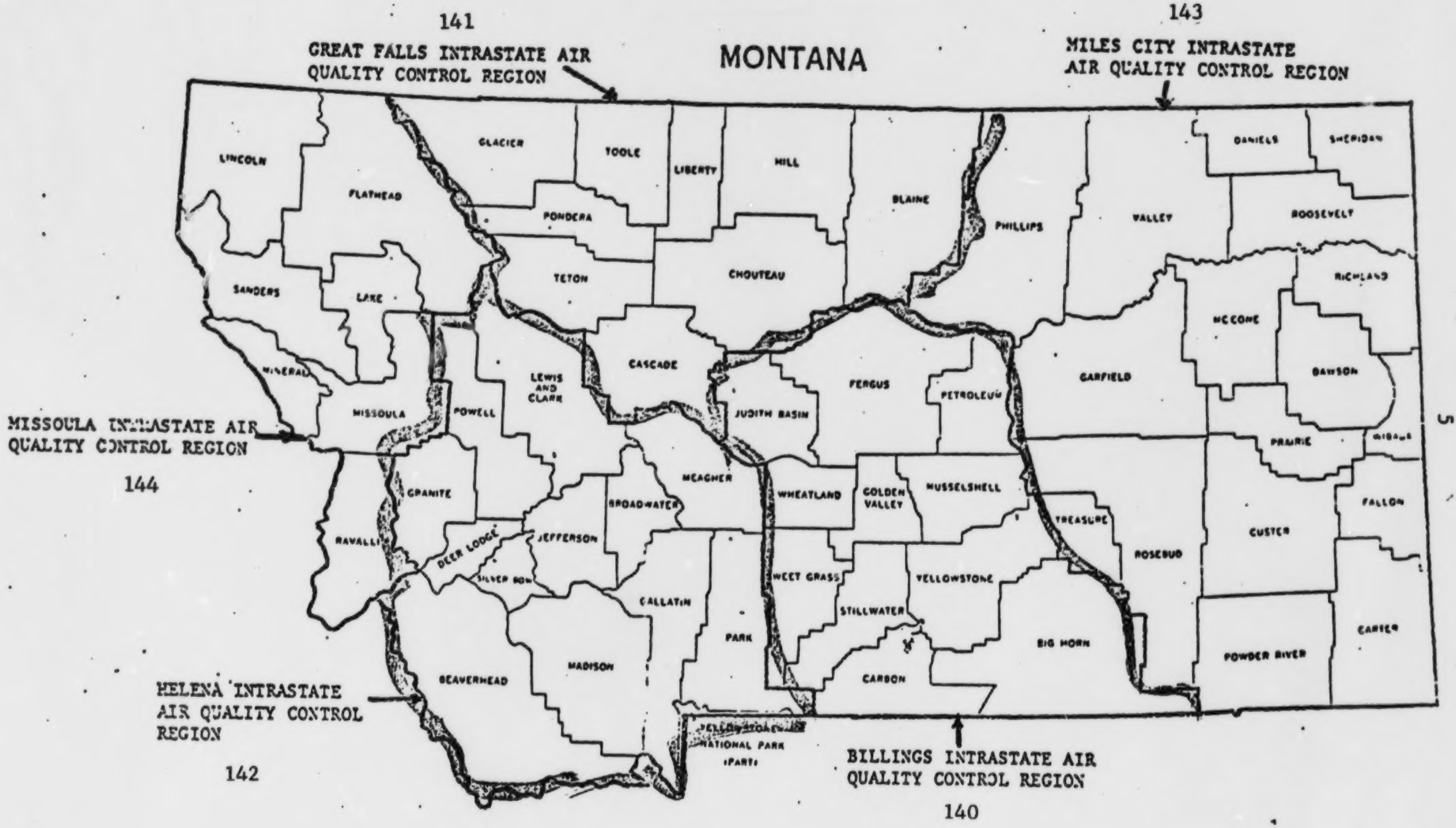

MONTANA
141
GREAT FALLS INTRASTATE AIR QUALITY CONTROL REGION
143
MILES CITY INTRASTATE AIR QUALITY CONTROL REGION
MISSOULA INTRASTATE AIR QUALITY CONTROL REGION
144
HELENA INTRASTATE AIR QUALITY CONTROL REGION
142
BILLINGS INTRASTATE AIR QUALITY CONTROL REGION
140
LINCOLN
FLATHEAD
GLACIER
TOOLE
LIBERTY
HILL
BLAINE
PHILLIPS
VALLEY
DANIELS
SHERIDAN
ROOSEVELT
SANDERS
LAKE
PONDERA
TETON
CHOUTEAU
RICHLAND
MCCONE
DAWSON
MINERAL
MISSOULA
POWELL
LEWIS AND CLARK
CASCADE
JUDITH BASIN
FERGUS
PETROLEUM
GARFIELD
PRAIRIE
WIBAUX
GRANITE
MEAGHER
BROADWATER
WHEATLAND
GOLDEN VALLEY
MUSSELSHELL
TREASURE
ROSEBUD
CUSTER
FALLON
RAVALLI
DEER LODGE
JEFFERSON
SILVER BOW
SWEET GRASS
STILLWATER
YELLOWSTONE
GALLATIN
PARK
BIG HORN
POWDER RIVER
CARTER
BEAVERHEAD
MADISON
CARBON
YELLOWSTONE NATIONAL PARK (PART)

FIGURE 1. AIR QUALITY CONTROL REGIONS OF MONTANA

TABLE 1. JURISDICTIONS INCLUDED WITHIN AIR QUALITY CONTROL REGIONS

County No.	140 Billings	141 Great Falls	142 Helena	143 Miles City	144 Missoula
1	Big Horn	Blaine	Beaverhead	Carter	Flathead
2	Carbon	Cascade	Broadwater	Custer	Lake
3	Fergus	Chouteau	Deer Lodge	Daniels	Lincoln
4	Golden Valley	Glacier	Gallatin	Dawson	Mineral
5	Judith Basin	Hill	Granite	Fallon	Missoula
6	Musselshell	Liberty	Jefferson	Garfield	Ravalli
7	Petroleum	Pondera	Lewis & Clark	McCone	Sanders
8	Stillwater	Teton	Madison	Phillips	
9	Sweetgrass	Toole	Meagher	Powder River	
10	Wheatland		Park	Prairie	
11	Yellowstone		Powell	Richland	
12			Silver Bow	Roosevelt	
13				Rosebud	
14				Sheridan	
15				Treasure	
16				Valley	
17				Wibaux	

NOT REPRODUCIBLE

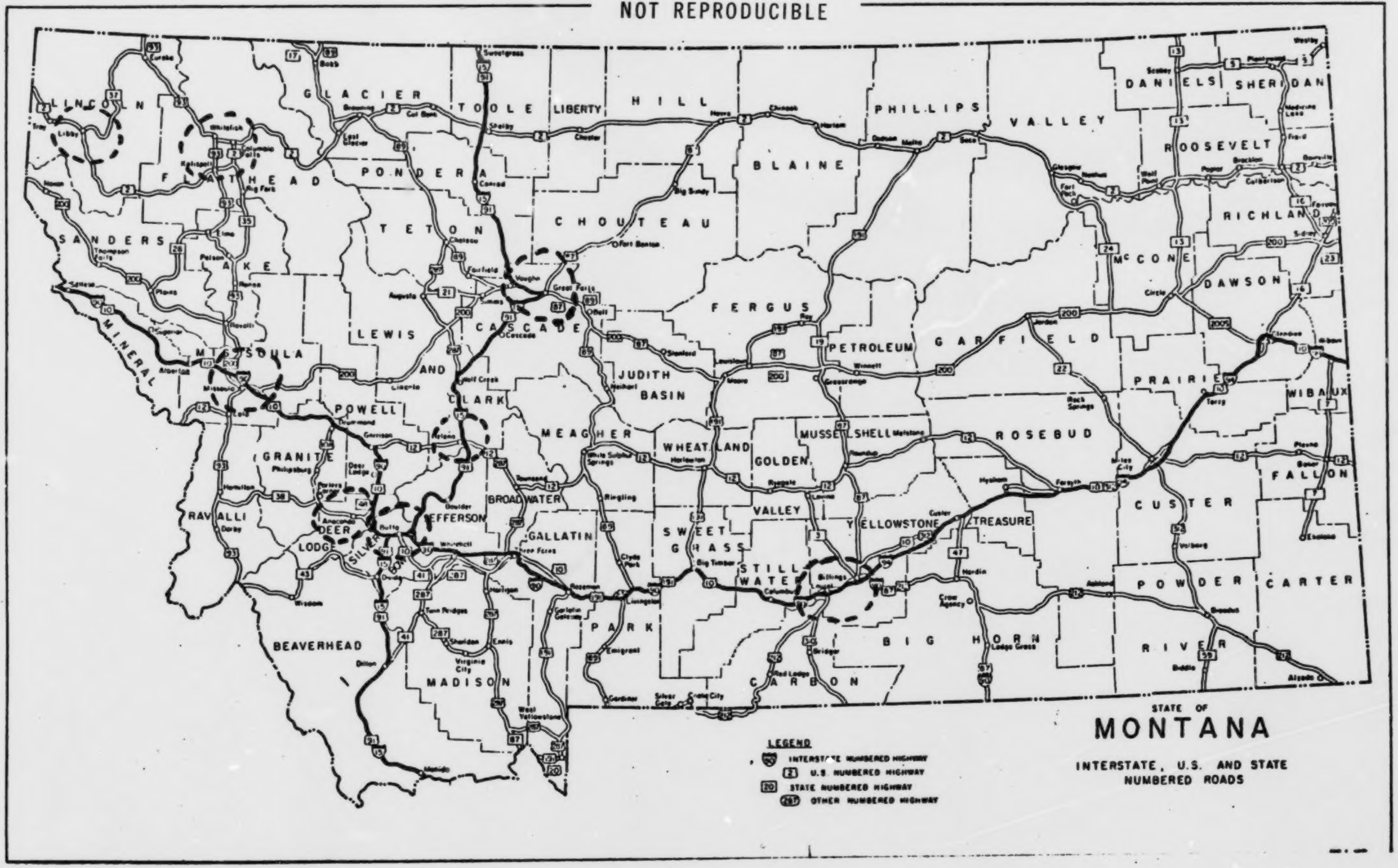

STATE OF
MONTANA
INTERSTATE, U.S. AND STATE NUMBERED ROADS
LEGEND
INTERSTATE NUMBERED HIGHWAY
U.S. NUMBERED HIGHWAY
STATE NUMBERED HIGHWAY
OTHER NUMBERED HIGHWAY
LINCOLN
FLATHEAD
GLACIER
TOOLE
LIBERTY
HILL
BLAINE
PHILLIPS
VALLEY
DANIELS
SHERIDAN
ROOSEVELT
RICHLAND
McCONE
DAWSON
SANDERS
LAKE
PONDERA
TETON
CHOUTEAU
FERGUS
PETROLEUM
GARFIELD
PRAIRIE
WIBAUX
MINERAL
MISSOULA
LEWIS AND CLARK
CASCADE
JUDITH BASIN
POWELL
MEAGHER
WHEATLAND
GOLDEN VALLEY
MUSSELSHELL
ROSEBUD
GRANITE
DEER LODGE
SILVER BOW
JEFFERSON
BROADWATER
GALLATIN
SWEET GRASS
STILLWATER
YELLOWSTONE
TREASURE
CUSTER
FALLON
RAVALLI
BEAVERHEAD
MADISON
PARK
CARBON
BIG HORN
POWDER RIVER
CARTER

FIGURE 2. LOCATION OF "HOT-SPOT" AREAS IN MONTANA

Another facet of the task was the evaluation of regulations. Allowable emissions (SO_2 and particulates) were to be calculated for each point source to which existing Montana State regulations applied. Similar calculations were to be made for all point sources in the eight "hot-spot" regions, according to the Proposed Model Regulations in the April 7, 1971, Federal Register(5). As a practical matter, application of the proposed Federal regulations was broadened to include most of the point sources.

The regulations applied were those proposed in the April 7, 1971, Federal Register. Revised Model Regulations for particulates and SO_2 have been issued (August 14, 1971 Federal Register)(6) since the completion of the emission inventory, which differ slightly from those initially proposed. Perhaps the largest change as far as Montana data are concerned is in sulfur emissions from nonferrous smelters. Initially, for example, allowable emissions from copper smelters were specified not to exceed:

$$Y = 0.2X$$

where X is input and Y is output, both in terms of sulfur. (This may have been an error, since a note indicated that this represented about 90% removal of sulfur.) [In the Montana State regulations (Reg. 90-008) allowable sulfur emissions were correctly defined as 10%.] In the August 14, 1971 revision, X is defined as sulfur, and Y not as sulfur but as sulfur dioxide, which is equivalent to a removal of 90% when stated in this fashion.

METHODOLOGY--INVENTORY TECHNIQUES AND ASSUMPTIONS

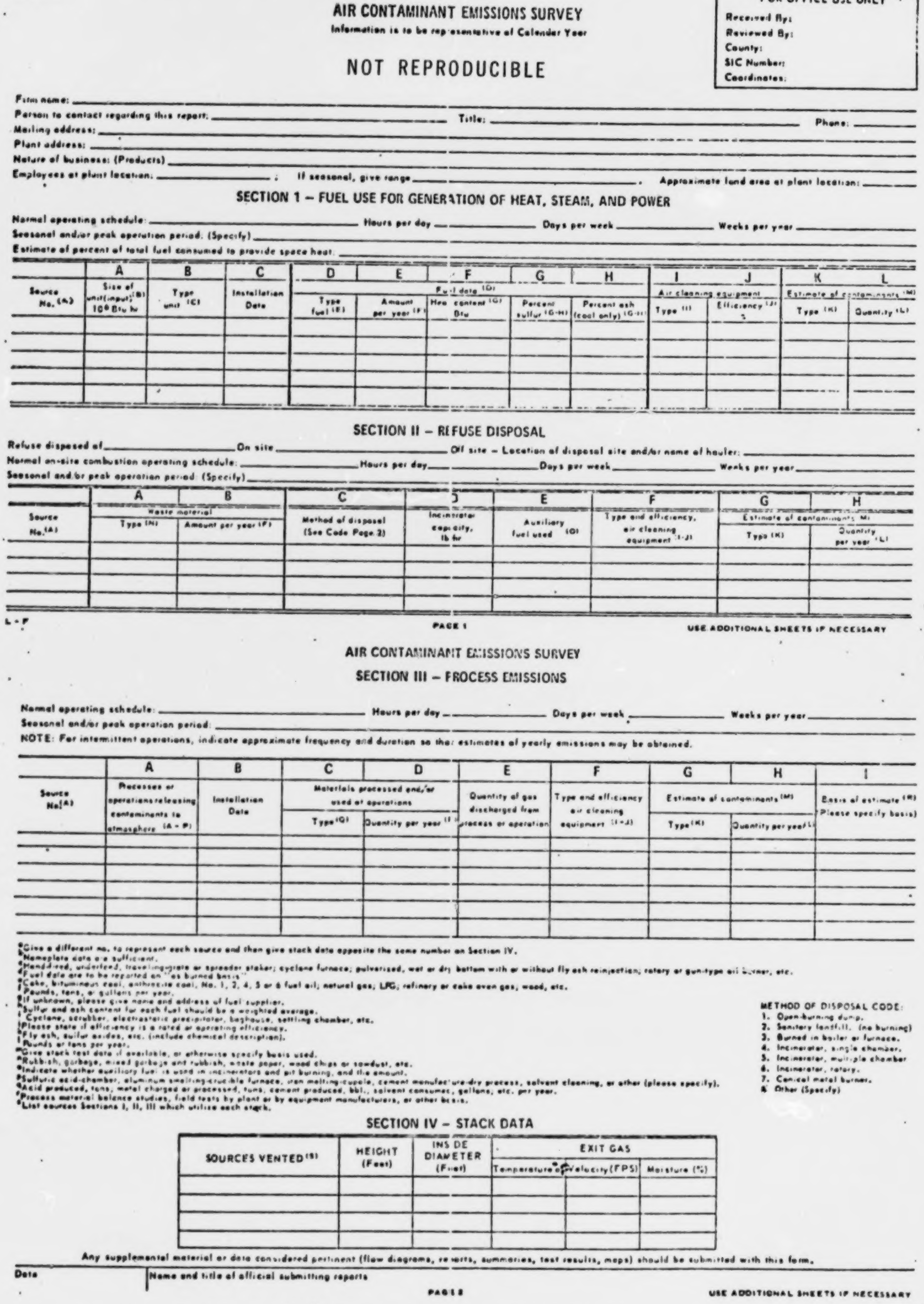
Point Sources

Data Acquisition

The first program meeting with Montana Air Pollution Control Division staff and EPA staff was held in Helena, Montana, on April 16, 1971. Schedule established at this meeting for preparation of a list and mailing of the questionnaires was one week later, April 23, 1971. This very short time caused some problems. However, the list turned out to be reasonably complete in spite of the necessary haste, although a few minor sources were missed.

The candidate list of potential point sources was prepared from a number of sources of which the main one was the "Montana Directory of Manufacturers"(7). This listing of manufacturers by SIC categories was extremely useful in obtaining names of strictly industrial establishments. However, like all such publications, it was partially obsolete by the time it was issued, and contained names of firms which have ceased operations, or changed names, and failed to list newly formed establishments. Also, it did not list such processors and quasimanufacturers as country grain elevators or asphalt batch plants, for example.

Treatment of candidates in the manufacturing category was straightforward. A list of establishments in those industries at all likely to be sources of air pollutants was prepared from the Directory of Manufacturers, supplemented by other names drawn from the personal knowledge of the Montana Air Pollution Control staff. Specialized questionnaires designed by EPA were used for sawmills, asphalt batching plants, concrete batching plants, refineries, grain handlers, and dry cleaners. There were advantages and disadvantages to the use of these specialized forms; in retrospect, it seems that it would probably have been preferable, from an information-gathering point of view, to have also supplemented these with generalized questionnaires along the lines of the one suggested by EPA (illustrated in Figure 3).



Return To:

AIR CONTAMINANT EMISSIONS SURVEY

Information is to be representative of Calendar Year

NOT REPRODUCIBLE

FOR OFFICE USE ONLY
Received By:
Reviewed By:
County:
SIC Number:
Coordinates:

Firm name:
Person to contact regarding this report: ______ Title: ______ Phone:
Mailing address:
Plant address:
Nature of business: (Products)
Employees at plant location: ______ ; If seasonal, give range ______ . Approximate land area at plant location:

SECTION 1 – FUEL USE FOR GENERATION OF HEAT, STEAM, AND POWER

Normal operating schedule: ______ Hours per day ______ Days per week ______ Weeks per year
Seasonal and/or peak operation period. (Specify)
Estimate of percent of total fuel consumed to provide space heat.

	A	B	C	D	E	F	G	H	I	J	K	L
				Fuel data (D)					Air cleaning equipment		Estimate of contaminants (M)	
Source No. (A)	Size of unit (input) (B) 10⁶ Btu hr	Type unit (C)	Installation Date	Type fuel (E)	Amount per year (F)	Heat content (G) Btu	Percent sulfur (G-H)	Percent ash (coal only) (G-H)	Type (I)	Efficiency (J) %	Type (K)	Quantity (L)

SECTION II – REFUSE DISPOSAL

Refuse disposed of ______ On site ______ Off site – Location of disposal site and/or name of hauler:
Normal on-site combustion operating schedule: ______ Hours per day ______ Days per week ______ Weeks per year
Seasonal and/or peak operation period (Specify)

	A	B	C	D	E	F	G	H
	Waste material						Estimate of contaminants (M)	
Source No. (A)	Type (N)	Amount per year (F)	Method of disposal (See Code Page 2)	Incinerator capacity, lb hr	Auxiliary fuel used (O)	Type and efficiency, air cleaning equipment (I-J)	Type (K)	Quantity per year (L)

L-F

PAGE 1

USE ADDITIONAL SHEETS IF NECESSARY

AIR CONTAMINANT EMISSIONS SURVEY

SECTION III – PROCESS EMISSIONS

Normal operating schedule: ______ Hours per day ______ Days per week ______ Weeks per year
Seasonal and/or peak operation period:
NOTE: For intermittent operations, indicate approximate frequency and duration so that estimates of yearly emissions may be obtained.

	A	B	C	D	E	F	G	H	I
			Materials processed and/or used at operations				Estimate of contaminants (M)		
Source No. (A)	Processes or operations releasing contaminants to atmosphere (A - P)	Installation Date	Type (Q)	Quantity per year (F)	Quantity of gas discharged from process or operation	Type and efficiency air cleaning equipment (I-J)	Type (K)	Quantity per year (L)	Basis of estimate (R) (Please specify basis)

[a] Give a different no. to represent each source and then give stack data opposite the same number on Section IV.
[b] Nameplate data are sufficient.
[c] Handfired, underfeed, traveling-grate or spreader stoker; cyclone furnace; pulverized, wet or dry bottom with or without fly ash reinjection; rotary or gun-type oil burner, etc.
[d] Fuel data are to be reported on "as burned basis"
[e] Coke, bituminous coal, anthracite coal, No. 1, 2, 4, 5 or 6 fuel oil; natural gas; LPG; refinery or coke oven gas, wood, etc.
[f] Pounds, tons, or gallons per year.
[g] If unknown, please give name and address of fuel supplier.
[h] Sulfur and ash content for each fuel should be a weighted average.
[i] Cyclone, scrubber, electrostatic precipitator, baghouse, settling chamber, etc.
[j] Please state if efficiency is a rated or operating efficiency.
[k] Fly ash, sulfur oxides, etc. (include chemical description).
[l] Pounds or tons per year.
[m] Give stack test data if available, or otherwise specify basis used.
[n] Rubbish, garbage, mixed garbage and rubbish, waste paper, wood chips or sawdust, etc.
[o] Indicate whether auxiliary fuel is used in incinerators and pit burning, and the amount.
[p] Sulfuric acid-chamber, aluminum smelting-crucible furnace, iron melting-cupola, cement manufacture-dry process, solvent cleaning, or other (please specify).
[q] Acid produced, tons, metal charged or processed, tons, cement produced, bbl., solvent consumed, gallons, etc. per year.
[r] Process material balance studies, field tests by plant or by equipment manufacturers, or other basis.
[s] List sources Sections I, II, III which utilize each stack.

METHOD OF DISPOSAL CODE:
1. Open-burning dump.
2. Sanitary landfill. (no burning)
3. Burned in boiler or furnace.
4. Incinerator, single chamber.
5. Incinerator, multiple chamber
6. Incinerator, rotary.
7. Conical metal burner.
8. Other (Specify)

SECTION IV – STACK DATA

SOURCES VENTED (S)	HEIGHT (Feet)	INSIDE DIAMETER (Feet)	EXIT GAS		
			Temperature °F	Velocity (FPS)	Moisture (%)

Any supplemental material or data considered pertinent (flow diagrams, reports, summaries, test results, maps) should be submitted with this form.

Date
Name and title of official submitting reports

PAGE 2

USE ADDITIONAL SHEETS IF NECESSARY

FIGURE 3. GENERALIZED EMISSION INVENTORY QUESTIONNAIRE

Data Treatment

Each returned questionnaire was considered individually and, on the basis of the data reported, calculations were made to ascertain those sources which had emissions in excess of the cut-off point for each of the five pollutants. For those sources with emissions above the cut-off point, point-source data forms supplied by the Office of Air Programs (see Figure C-1), were filled out, entering the appropriate data for either computer calculation of emissions or hand calculations of emissions based upon the emission factors given in "Air Pollutant Emission Factors(4).

The methodology and treatment of the data can probably best be described by category.

Sawmills. Lumbering is one of the principal industries of Montana, and one of the principal sources of air pollution, especially in the western half of the State. This results from the large amount of combustible waste generated, both in the forest and in the sawmill. There are scores of sawmills in the Missoula and Helena AQCR's, ranging from small operations sawing one or two million board feet a year, to the large industrially-operated mills cutting 50,000,000-100,000,000 board feet annually.

Less than half of the long winds up as marketable lumber, and in the current technology, most of the waste is burned in conical steel burners known as teepees or wigwam burners, from their shape. Poor combustion is frequently characteristic of teepee burners; studies aimed at defining emissions and methods of reducing them have been undertaken(8, 9). Teepee burners are and have been a high-priority concern of the State APC office, and progress is being made in this area. Better operation and better maintenance of teepee burners is being demanded by the State, and good control of both of these factors significantly reduces smoke emission. Smoke emission is also reduced by increasing operating temperature, and installation of auxiliary gas burners has been encouraged.

Much more nearly smoke-free operation is obtained when wood waste is burned in a boiler, and the larger mills are beginning to switch from teepees to what are known as hog-fuel boilers (from the fact that the waste wood and bark is hogged down in a mill to smaller chips for better burning before charging into the boiler).

Summation of the quantity of wood waste burned at sawmills is not a straightforward matter. As a waste product inherent to the process, it is regarded by the sawmill operator merely as unwanted trash, to be disposed of in the most expeditious and economical manner possible. Thus, little attention is generally paid to the amount burned, and estimates vary widely. Some of the larger and more competent operators do have a fairly good idea of the tonnage burned per year.

Therefore, another approach to estimating waste burning was used. Since each sawmill knows quite accurately how many board feet are produced. these quantities were related to waste produced. The Forestry Research Laboratory of Oregon State University has been very active for a number of years in the field of teepee burners and in relating waste generation to lumber production, and several of their publications were the basis of much of the estimating. While their results are based on Oregon timber, these were regarded as also applicable to Montana's timber.

Relationship of waste production to lumber production was described in some detail by Corder(10) based on data obtained in 1953. The production tables were updated in 1967(11) and found to have changed very little. These tables break down waste production according to method of generation, as shown by the following data from the 1967 revision:

Table 2. Relationship Between Production of Lumber and Waste

	Average Residues Developed from Producing 1000 Boardfeet of Lumber in Oregon in 1967	
	Dry Weight, Tons	
Wood Residue	Western Oregon	Eastern Oregon
Slabs, Edgings, Sawmill trim	.540	.480
Sawdust	.297	.264
Planer trim	.040	.036
Planer shavings	.216	.192
Total Wood Residue	1.093	.972
Bark	.285	.228
Total, Wood & Bark	1.378	1.200
Lumber	.878	.780
Whole Log	2.256	1.980

Although the differences between Eastern and Western Oregon were not great, Eastern Oregon was considered to be more like Montana and these figures were selected. Nominal values used were 0.2 tons/M boardfeet if only bark was burned, and 1.20-1.25 for incineration of total sawmill residue.

It was necessary to adjust residues for some mills in order to account for other disposition. Some mills are chipping or shredding the bark for sale as animal bedding. Quite a few mills within about a 120-150 mile-radius of Missoula are marketing substantial portions of their residues to the Hoerner-Waldorf paper mill or to the new Evans Products Company particle board plant, and one mill is pressing residues into small synthetic fire place logs (Prest-o-logs). Establishment of a few more such operations in Western Montana would be quite helpful in reducing the sawmill waste burning problem.

A number of mills using hog-fuel boilers reported their wood waste consumption rate in terms of pounds of steam produced per hour. Conversion factor used was 1 ton of dry wood fuel per 10,000 lbs of steam produced (2 tons of as-received wood), taken from Corder(9). A similar value can be derived from a typical average heating value for mixed wood and bark of 8800 Btu/lb (dry basis). Per dry ton this is 17.6×10^6 Btu. Approximately 2.3×10^6 Btu will be required to heat and vaporize the 1 ton of water contained in the 2 tons of as-received wood, leaving 15.3×10^6 Btu net. At a nominal boiler efficiency of 75%, this is sufficient to produce 10,000 lb of steam at 100 psig.

The composition of wood is also required to calculate the allowable particulate emissions under Montana Regulation 90-014, which are specified as not over 0.2 grains per standard cubic foot, corrected to 12 percent CO_2. The derivation of an allowable value in terms of pounds of particulate per ton of waste fired is presented in Appendix B.

Refineries and Electric Utilities. There are 7 major refineries in Montana, and four utility central power stations. Together, these two categories account for a significant fraction of the total industrial fuel consumed in the state; most of the annual industrial coal consumption is accounted for by two of the utility generating plants.

Treatment of the data was straightfoward for each of these categories, and the data furnished in each were quite complete.

Smelters. Smelters and related mineral processing industries comprise one of the largest industrial categories in Montana (from an emission point of view) and are significant consumers of fuel; natural gas is the preponderant fuel and fuel-emissions are accordingly minor. However, tremendous quantities of SO_2 result from processing operations. The data supplied were reasonably complete, and no unusual assumptions were necessary to treat them.

Concrete Batching Plants. Response from concrete batching plants was only average; 30 usable returns from 64 questionnaires. While concrete batching plants are point sources for particulate emissions and can be local nuisances, they do not constitute a major air quality problem in Montana, and it appeared acceptable to estimate the production of those not responding, based on the data from those that did.

The list of concrete batching plants was taken from the Directory of Manufacturers(7), which also categorizes each manufacturer by number of employees, as follows:

Size	No. of Employees	Size	No. of Employees
A	0-3	E	51-100
B	4-10	F	101-250
C	11-20	G	251-500
D	21-50	H	Over 500

Averaging the production of the 30 respondents, the following approximations were found:

Size Plant	Tons/year	Aver. Prod. Rate, tons/hr
A	12,000	20-30
B	15,000	30-40
C	25,000	50
D	40,000	100

These values were applied to the non-respondents to obtain their estimated emissions. None of these estimated sources were credited with any dust control equipment, and so their particulate emissions may be somewhat high.

(This same technique of using number of employees as given by the Directory of Manufacturers was useful in estimating importance and possible production levels of other types of sources, and in assigning priorities for follow-ups.)

Area Sources

Bases for Apportioning

The underlying basis for almost all apportioning of non-point source emissions is population, either directly, or indirectly through some secondary population-related variable, such as manufacturing employees or retail establishments. Population data used were taken from the 1970 Census of Population (Advance Report)(12). Two tabulations from this were utilized; population by counties, used for apportioning domestic heating; and to determine whether a county is rural or urban (for apportioning vehicle travel), and the population of places, used in the calculations of open burning on dumps.

Since the data in these two tables are basic to much of the area-source apportioning, they are reproduced in Tables 3 and 4. Two comments on these figures are pertinent. First, the population increase in Montana between 1960 and 1970 was slight, only 19,642 persons, or 2.9 percent. Second, it is evident that there was a strong migration from rural to urban and metropolitan areas; the smaller towns and the rural counties actually lost population during the decade. From these facts it can be concluded that data for the years immediately prior to 1970 are probably good approximations for 1970, except where the rural-urban factor is important.

Fuel Apportioning - Coal

Apportioning factor finally used for domestic fuel was population. Use of the data in the 1960 Housing Census(13) was considered initially, since this broke down domestic fuel usage by all fuel types: gasoline, oil, kerosine, coal, LPG and wood. Later, it was disclosed that there were a number of areas in Montana in which gas was not available in 1960 and in which almost all of the coal and oil used for domestic heating was consumed. However, discussion with the major supplier of natural

Table 3. Population of Counties: 1970 and 1960

NOT REPRODUCIBLE

[For information on boundary changes and meaning of symbols, see text]

The State Urban and Rural	Total population 1970	Urban				Rural			Total population 1960	Percent change, 1960 to 1970
		Total urban	Percent of total	Urbanized areas	Other urban	Total rural	Places of 1,000 to 2,500	Other rural		
THE STATE. .	694 409	370 676	53.4	142 102	228 574	323 733	53 685	270 048	674 767	2.9
BEAVERHEAD	8 187	4 548	55.6	-	4 548	3 639	-	3 639	7 194	13.8
BIG HORN	10 057	2 733	27.2	-	2 733	7 324	-	7 324	10 007	0.5
BLAINE	6 727	-	-	-	-	6 727	2 907	3 820	8 091	-16.9
BROADWATER	2 526	-	-	-	-	2 526	1 371	1 155	2 804	-9.9
CARBON	7 080	-	-	-	-	7 080	1 844	5 236	8 317	-14.9
CARTER	1 956	-	-	-	-	1 956	-	1 956	2 493	-21.5
CASCADE.	81 804	70 905	86.7	70 905	-	10 899	-	10 899	73 418	11.4
CHOUTEAU	6 473	-	-	-	-	6 473	1 863	4 610	7 348	-11.9
CUSTER	12 174	9 023	74.1	-	9 023	3 151	-	3 151	13 227	-8.0
DANIELS.	3 083	-	-	-	-	3 083	1 486	1 597	3 755	-17.9
DAWSON	11 269	6 305	55.9	-	6 305	4 964	-	4 964	12 314	-8.5
DEER LODGE	15 652	9 771	62.4	-	9 771	5 881	-	5 881	18 640	-16.0
FALLON	4 050	2 584	63.8	-	2 584	1 466	-	1 466	3 997	1.3
FERGUS	12 611	6 437	51.0	-	6 437	6 174	-	6 174	14 018	-10.0
FLATHEAD	39 460	16 527	41.9	-	16 527	22 933	-	22 933	32 965	19.7
GALLATIN	32 505	18 670	57.4	-	18 670	13 835	2 495	11 340	26 045	24.8
GARFIELD	1 796	-	-	-	-	1 796	-	1 796	1 981	-9.3
GLACIER.	10 783	4 004	37.1	-	4 004	6 779	1 700	5 079	11 565	-6.8
GOLDEN VALLEY.	931	-	-	-	-	931	-	931	1 203	-22.6
GRANITE.	2 737	-	-	-	-	2 737	1 128	1 609	3 014	-9.2
HILL	17 358	10 558	60.8	-	10 558	6 800	1 073	5 727	18 653	-6.9
JEFFERSON.	5 238	-	-	-	-	5 238	2 377	2 861	4 297	21.9
JUDITH BASIN	2 667	-	-	-	-	2 667	-	2 667	3 085	-13.5
LAKE	14 445	-	-	-	-	14 445	3 811	10 634	13 104	10.2
LEWIS AND CLARK. . . .	33 281	22 730	68.3	-	22 730	10 551	1 651	8 900	28 006	18.8
LIBERTY.	2 359	-	-	-	-	2 359	-	2 359	2 624	-10.1
LINCOLN.	18 063	3 286	18.2	-	3 286	14 777	2 241	12 536	12 537	44.1
MC CONE.	2 875	-	-	-	-	2 875	-	2 875	3 321	-13.4
MADISON.	5 014	-	-	-	-	5 014	-	5 014	5 211	-3.8
MEAGHER.	2 122	-	-	-	-	2 122	1 200	922	2 616	-18.9
MINERAL.	2 958	-	-	-	-	2 958	-	2 958	3 037	-2.6
MISSOULA	58 263	43 531	74.7	-	43 531	14 732	1 492	13 240	44 663	30.5
MUSSELSHELL.	3 734	-	-	-	-	3 734	2 116	1 618	4 888	-23.6
PARK	11 197	6 883	61.5	-	6 883	4 314	-	4 314	13 168	-15.0
PETROLEUM.	675	-	-	-	-	675	-	675	894	-24.5
PHILLIPS	5 386	-	-	-	-	5 386	2 195	3 191	6 027	-10.6
PONDERA.	6 611	2 770	41.9	-	2 770	3 841	-	3 841	7 653	-13.6
POWDER RIVER	2 862	-	-	-	-	2 862	-	2 862	2 485	15.2
POWELL	6 660	4 306	64.7	-	4 306	2 354	-	2 354	7 002	-4.9
PRAIRIE.	1 752	-	-	-	-	1 752	-	1 752	2 318	-24.4
RAVALLI.	14 409	-	-	-	-	14 409	2 499	11 910	12 341	16.8
RICHLAND	9 837	4 543	46.2	-	4 543	5 294	-	5 294	10 504	-6.3
ROOSEVELT.	10 365	3 095	29.9	-	3 095	7 270	1 389	5 881	11 731	-11.6
ROSEBUD.	6 032	-	-	-	-	6 032	1 873	4 159	6 187	-2.5
SANDERS.	7 093	-	-	-	-	7 093	2 402	4 691	6 880	3.1
SHERIDAN	5 779	-	-	-	-	5 779	2 381	3 398	6 458	-10.5
SILVER BOW	41 981	34 005	81.0	-	34 005	7 976	4 465	3 511	46 454	-9.6
STILLWATER	4 632	-	-	-	-	4 632	1 173	3 459	5 526	-16.2
SWEET GRASS.	2 980	-	-	-	-	2 980	1 592	1 388	3 290	-9.4
TETON.	6 116	-	-	-	-	6 116	1 586	4 530	7 295	-16.2
TOOLE.	5 839	3 111	53.3	-	3 111	2 728	-	2 728	7 904	-26.1
TREASURE	1 069	-	-	-	-	1 069	-	1 069	1 345	-20.5
VALLEY	11 471	4 700	41.0	-	4 700	6 771	-	6 771	17 080	-32.8
WHEATLAND.	2 529	-	-	-	-	2 529	1 375	1 154	3 026	-16.4
WIBAUX	1 465	-	-	-	-	1 465	-	1 465	1 698	-13.7
YELLOWSTONE.	87 367	75 651	86.6	71 197	4 454	11 716	-	11 716	79 016	10.6
YELLOWSTONE NATL. PARK	64	-	-	-	-	64	-	64	47	36.2

Table 4. Population of Places: 1970 and 1960

[For information on boundary changes and meaning of symbols see text]

All Incorporated Places Unincorporated Places of 1,000 or More	Counties	1970	1960	Percent change
ALBERTON TOWN	MINERAL	363	356	2.0
ANACONDA CITY	DEER LODGE	9 771	12 054	-18.9
BAINVILLE TOWN	ROOSEVELT	217	285	-23.9
BAKER CITY	FALLON	2 584	2 365	9.3
BEARCREEK TOWN	CARBON	31	61	-49.2
BELGRADE TOWN	GALLATIN	1 307	1 057	23.7
BELT CITY	CASCADE	656	757	-13.3
BIG SANDY TOWN	CHOUTEAU	827	954	-13.3
BIG TIMBER CITY	SWEET GRASS	1 592	1 660	-4.1
BILLINGS CITY	YELLOWSTONE	61 581	52 851	16.5
BOULDER TOWN	JEFFERSON	1 342	1 394	-3.7
BOZEMAN CITY	GALLATIN	18 670	13 361	39.7
BRIDGER TOWN	CARBON	717	824	-13.0
BROADUS TOWN	POWDER RIVER	799	628	27.2
BROADVIEW TOWN	YELLOWSTONE	123	160	-23.1
BROCKTON TOWN	ROOSEVELT	401	367	9.3
BROWNING TOWN	GLACIER	1 700	2 011	-15.5
BUTTE CITY	SILVER BOW	23 368	27 877	-16.2
CASCADE TOWN	CASCADE	714	604	18.2
CENTERVILLE-DUBLIN GULCH (U)	SILVER BOW	2 284	3 398	-32.8
CHESTER TOWN	LIBERTY	936	1 158	-19.2
CHINOOK TOWN	BLAINE	1 813	2 326	-22.1
CHOTEAU CITY	TETON	1 586	1 966	-19.3
CIRCLE TOWN	MC CONE	964	1 117	-13.7
CLYDE PARK TOWN	PARK	244	253	-3.6
COLUMBIA FALLS TOWN	FLATHEAD	2 652	2 132	24.4
COLUMBUS TOWN	STILLWATER	1 173	1 281	-8.4
CONRAD CITY	PONDERA	2 770	2 665	3.9
CULBERTSON TOWN	ROOSEVELT	821	919	-10.7
CUT BANK CITY	GLACIER	4 004	4 539	-11.8
DARBY TOWN	RAVALLI	538	398	35.2
DEER LODGE CITY	POWELL	4 306	4 681	-8.0
DENTON TOWN	FERGUS	398	410	-2.9
DILLON CITY	BEAVERHEAD	4 548	3 690	23.3
DODSON TOWN	PHILLIPS	196	313	-37.4
DRUMMOND TOWN	GRANITE	494	577	-14.4
DUTTON TOWN	TETON	415	504	-17.7
EAST HELENA TOWN	LEWIS AND CLARK	1 651	1 490	10.8
EKALAKA TOWN	CARTER	663	738	-10.2
ENNIS TOWN	MADISON	501	525	-4.6
EUREKA TOWN	LINCOLN	1 195	1 229	-2.8
FAIRFIELD TOWN	TETON	638	752	-15.2
FAIRVIEW CITY	RICHLAND	956	1 006	-5.0
FLAXVILLE CITY	DANIELS	185	262	-29.4
FLORAL PARK (U)	SILVER BOW	5 113	4 079	25.3
FORSYTH CITY	ROSEBUD	1 873	2 032	-7.8
FORT BENTON CITY	CHOUTEAU	1 863	1 887	-1.3
FROID TOWN	ROOSEVELT	330	418	-21.1
FROMBERG TOWN	CARBON	364	367	-0.8
GERALDINE TOWN	CHOUTEAU	370	364	1.6
GLASGOW CITY	VALLEY	4 700	6 398	-26.5
GLENDIVE CITY	DAWSON	6 305	7 058	-10.7
GRASS RANGE TOWN	FERGUS	181	222	-18.5
GREAT FALLS CITY	CASCADE	60 091	55 244	8.8
HAMILTON CITY	RAVALLI	2 499	2 475	1.0
HARDIN CITY	BIG HORN	2 733	2 789	-2.0
HARLEM CITY	BLAINE	1 094	1 267	-13.7
HARLOWTON CITY	WHEATLAND	1 375	1 734	-20.7
HAVRE CITY	HILL	10 558	10 740	-1.7
HAVRE NORTH (U)	HILL	1 073	1 168	-8.1
HELENA CITY	LEWIS AND CLARK	22 730	20 227	12.4
HINGHAM TOWN	HILL	262	254	3.1
HOBSON TOWN	JUDITH BASIN	192	207	-7.2
HOT SPRINGS TOWN	SANDERS	664	585	13.5
HYSHAM TOWN	TREASURE	373	494	-24.5
ISMAY TOWN	CUSTER	40	59	-32.2
JOLIET TOWN	CARBON	412	452	-8.8
JORDAN TOWN	GARFIELD	529	557	-5.0
JUDITH GAP CITY	WHEATLAND	160	185	-13.5
KALISPELL CITY	FLATHEAD	10 526	10 151	3.7
KEVIN TOWN	TOOLE	250	375	-33.3
LAUREL CITY	YELLOWSTONE	4 454	4 601	-3.2
LAVINA TOWN	GOLDEN VALLEY	169	212	-20.3
LEWISTOWN CITY	FERGUS	6 437	7 408	-13.1
LIBBY CITY	LINCOLN	3 286	2 828	16.2
LIMA TOWN	BEAVERHEAD	351	397	-11.6
LIVINGSTON CITY	PARK	6 883	8 229	-16.4
LODGE GRASS TOWN	BIG HORN	806	687	17.3
MALMSTROM (U)	CASCADE	8 374	...	...
MALTA CITY	PHILLIPS	2 195	2 239	-2.0
MANHATTAN TOWN	GALLATIN	816	889	-8.2
MC QUEEN-EAST BUTTE (U)	SILVER BOW	1 084	...	...
MEDICINE LAKE TOWN	SHERIDAN	393	452	-13.1
MELSTONE TOWN	MUSSELSHELL	227	266	-14.7
MILES CITY CITY	CUSTER	9 023	9 665	-6.6
MISSOULA CITY	MISSOULA	29 497	27 090	8.9
MISSOULA SOUTH (U)	MISSOULA	4 886	...	...
MISSOULA WEST (U)	MISSOULA	9 148	...	...
MOORE TOWN	FERGUS	219	216	1.4
NASHUA TOWN	VALLEY	513	796	-35.6

Table. 4. Population of Places: 1970 and 1960–Continued

[For information on boundary changes and meaning of symbols see text]

All Incorporated Places Unincorporated Places of 1,000 or More	Counties	1970	1960	Percent change
NEIHART TOWN	CASCADE	109	150	-27.3
OPHEIM TOWN	VALLEY	306	457	-33.0
OUTLOOK TOWN	SHERIDAN	153	226	-32.3
PHILIPSBURG TOWN	GRANITE	1 128	1 107	1.9
PLAINS TOWN	SANDERS	1 046	769	36.0
PLENTYWOOD CITY	SHERIDAN	2 381	2 121	12.3
PLEVNA TOWN	FALLON	189	263	-28.1
POLSON CITY	LAKE	2 464	2 314	6.5
POPLAR CITY	ROOSEVELT	1 389	1 565	-11.2
RATTLESNAKE (U)	MISSOULA	1 492	...	...
RED LODGE CITY	CARBON	1 844	2 278	-19.1
REXFORD TOWN	LINCOLN	243	...	...
RICHEY TOWN	DAWSON	389	480	-19.0
RONAN CITY	LAKE	1 347	1 334	1.0
ROUNDUP CITY	MUSSELSHELL	2 116	2 842	-25.5
RYEGATE TOWN	GOLDEN VALLEY	261	314	-16.9
SACO TOWN	PHILLIPS	356	490	-27.3
ST. IGNATIUS TOWN	LAKE	925	940	-1.6
SCOBEY CITY	DANIELS	1 486	1 726	-13.9
SHELBY CITY	TOOLE	3 111	4 017	-22.6
SHERIDAN TOWN	MADISON	636	539	18.0
SIDNEY CITY	RICHLAND	4 543	4 564	-0.5
SILVER BOW PARK (U)	SILVER BOW	5 524	4 798	15.1
STANFORD TOWN	JUDITH BASIN	505	615	-17.9
STEVENSVILLE TOWN	RAVALLI	829	784	5.7
SUNBURST TOWN	TOOLE	604	882	-31.5
SUPERIOR TOWN	MINERAL	993	1 242	-20.0
TERRY CITY	PRAIRIE	870	1 140	-23.7
THOMPSON FALLS TOWN	SANDERS	1 356	1 274	6.4
THREE FORKS TOWN	GALLATIN	1 188	1 161	2.3
TOWNSEND TOWN	BROADWATER	1 371	1 528	-10.3
TROY TOWN	LINCOLN	1 046	855	22.3
TWIN BRIDGES TOWN	MADISON	613	509	20.4
VALIER TOWN	PONDERA	651	724	-10.1
VIRGINIA CITY TOWN	MADISON	149	194	-23.2
WALKERVILLE CITY	SILVER BOW	1 097	1 453	-24.5
WESTBY TOWN	SHERIDAN	287	309	-7.1
WEST YELLOWSTONE TOWN	GALLATIN	756	...	...
WHITEFISH CITY	FLATHEAD	3 349	2 965	13.0
WHITEHALL TOWN	JEFFERSON	1 035	898	15.3
WHITE SULPHUR SPRINGS CITY	MEAGHER	1 200	1 519	-21.0
WIBAUX TOWN	WIBAUX	644	766	-15.9
WINIFRED TOWN	FERGUS	190	220	-13.6
WINNETT TOWN	PETROLEUM	271	360	-24.7
WOLF POINT CITY	ROOSEVELT	3 095	3 585	-13.7

gas disclosed the fact that new lines had been constructed to these areas over the last 10 years and most of these areas were now served by gas, so that the 1960 fuel pattern had totally changed. Updated domestic fuel data from the 1970 census will presumably be available within the next year, but were not available for the emission inventory. Hence, the decision was made to use direct population count. Actually, the error, if any, introduced by use of this apportioning factor is probably slight; gas is so preponderantly the domestic heating fuel in Montana that the quantities of coal and oil to be apportioned are a minor part of the total domestic fuel.

An approximation is possible of the relative numbers of dwelling units now using coal, oil, or gas from certain data on gas usage. There are two major gas suppliers in Montana. Montana-Dakota-Utilities (MDU) supplies the more sparsely populated eastern portion of the state, primarily that in AQCR 143, plus the Billings area. MDU indicated that they have had about 99% saturation in their area for the past decade, and there were no major new service areas acquired. Thus, MDU growth was judged to be primarily in the Billings area where there was a population increase of 8730 between 1960 and 1970.

Montana Power Company has acquired major new service areas since 1960 in the Kalispell and Dillon areas. It was indicated by the MP marketing staff that, in general, 90% saturation is reached in a new area within 5 years; most of the towns served average 95%. Since 1960 the number of domestic customers directly served increased as follows:

1960	62,058	
1965	74,759	
1970	84,985	
	22,927	net increase

In addition, MP markets gas wholesale to city utilities in Great Falls and Shelby, in which two cities there was also a net increase in population, and presumably in gas customers. Based on the 1960 Housing Census, the average number of persons per Montana dwelling unit in 1960 was 3.35; this figure was assumed to be valid also for 1970. Applying this figure to the increase in population in Billings and Great Falls indicated there were another 4,000 dwelling units in addition to those reported by the Montana Power figures, for a total of approximately 27,000 additional dwellings now heated with gas. It is also assumed that this growth, except for that portion due to the increase in population, was at the expense of other fuels, in proportion to their number. The increase in total state population from 1960 to 1970, 19,633 persons, would be equivalent to 5,850 new dwelling units at 3.35 persons/D.U. Subtracting this from the 27,000 total leaves an estimated 21,150 dwelling units switching from other fuels to gas.

From this, calculated approximate 1970 usage of the principal fuels compares with 1960 fuel usage as follows:

	Dwelling Units			
	1960			1970
Gas	123,435	+21,150 + 5,850	=	150,500
Oil	38,444	-10,300	=	28,000
Coal	14,036	- 3,800	=	10,000
Wood	11,700	- 3,150	=	8,500
LP Gas & Others	14,482	- 3,850	=	10,800
TOTAL	202,097			207,800

Quantity of coal burned for domestic heating can be approximated, using factors indicated by Bierbaum and Gedgaudas(3), and degree-day data. The following degree-day data were obtained for eight cities in Montana from the Climatic Atlas of the U.S. (14):

	Degree-days		Degree-days
Billings	7049	Helena	8129
Glasgow	8996	Kalispell	8191
Great Falls	7750	Miles City	7723
Havre	8700	Missoula	8125

Average of these 8 values is 8082. Average rooms per dwelling unit, from the 1960 Housing Census data(13) is 4.3. The 1960 Housing Census indicated use of coal for water heating or cooking was minor, and these uses were neglected. Bierbaum and Gedgaudas indicated 0.0012 tons of coal were required per degree-day for a 5.0 room dwelling unit. Ratioing this to the 4.3 room average in Montana, calculated 1970 residential coal consumption was:

$$10{,}000 \times 8{,}082 \times 0.0012 \times \frac{4.3}{5.0} = 83{,}400 \text{ tons/yr}$$

This quantity was apportioned over the state on a population basis.

Coal usage is reported yearly by the U. S. Bureau of Mines; latest tabulation available is that for 1969(15). Larger states are totalled individually, but Montana and Idaho data are combined, as summarized below:

	Montana and Idaho Usage; 1969, tons		
	Coal Sources		
	Utah	Wyoming	Montana & Washington
Electric Utilities	-	-	652,000
Retail Dealers	198,000	21,000	9,000
All Others	55,000	111,000	19,000
TOTAL	253,000	132,000	680,000

Since the states are somewhat similar in character, and have populations nearly the same --698,275 in Idaho and 694,409 in Montana--a proportional division appears reasonable. Total non-utility coal in 1969 was 413,000 tons, of which Montana's proportionate share is estimated to be 206,000 tons. This is to be apportioned over residential, commercial and institutional, and industrial use.

Whereas the 1963 Manufacturers Census (16) tabulated industrial coal usage, the corresponding 1967 Manufacturers Census (17) does not. It is therefore necessary to extrapolate to 1970 the data contained in the 1963 census:

Year	Industrial Usage
1954	141,000 tons
1958	125,000 "
1962	117,000 "

While the data are scattered, an estimate of 80,000 tons of industrial coal in 1970 appears reasonable. The two identified point sources accounted for 72,300 tons, leaving a non-point source industrial coal usage of only 7,700 tons. Since there were very few industrial coal users and it is believed the point source coverage was good, the good agreement with identified users appears reasonable. Non-point source coal was apportioned on the basis of manufacturing employees per county, taken from the 1967 Census of Manufacturers (17). These data are shown in Table 5. By difference, the coal to be allocated to commercial and institutional users is 42,600 tons.

Commercial and institutional fuel usage can be apportioned on the basis of either the number of retail establishments or on the number of wholesale establishments, but not both; the EPA computer program will accept only one parameter. Of the two, retail establishments had the larger numbers and the smoother data in Montana, and was selected as the basis for apportioning. Latest data are from the 1967 Census of Business (18), which are reproduced in Table 6.

Summarizing, 1970 Montana coal consumption was distributed as follows:

Category	Apportioning Basis	Tons
Residential	Population	83,400
Commercial & Institutional	Retail Establishments	42,600
Point Source Industrial	Questionnaires	72,300
Non-point Source Industrial	Mfg. Employees	7,700
		206,000

TABLE 5. General Statistics for Standard Metropolitan Statistical Areas, Counties, and Selected Cities: 1967 and 1963

Standard metropolitan statistical area, county, and city	1967											1963	
	Establishments		All employees		Production workers			Value added by manufacture (million dollars)	Cost of materials (million dollars)	Value of shipments (million dollars)	Capital expenditures, new (million dollars)	All employees (1,000)	Value added by manufacture (million dollars)
	Total (number)	With 20 employees or more (number)	Number (1,000)	Payroll (million dollars)	Number (1,000)	Man-hours (millions)	Wages (million dollars)						
MONTANA, TOTAL	923	191	20.4	129.9	16.1	32.1	96.4	311.6	660.2	967.3	49.9	20.2	236.2
STANDARD METROPOLITAN STATISTICAL AREAS													
BILLINGS	102	24	2.7	19.3	1.8	3.7	12.0	71.8	180.5	253.9	12.6	2.5	46.3
GREAT FALLS	59	23	2.5	16.1	1.7	3.3	10.2	65.3	163.8	209.6	2.5	2.9	38.3
COUNTIES													
BEAVERHEAD*	6	-	(Z)	.1	(Z)	(Z)	(Z)	.1	.1	.2	(D)	(Z)	(D)
BIG HORN	8	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	.2	(D)
BLAINE	5	-	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(Z)	(D)
BROADWATER	6	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(Z)	.5
CARBON*	7	1	.1	.2	.1	.1	.1	.4	.8	1.2	(Z)	.1	.3
CARTER*	1	-	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
CASCADE	59	23	2.5	16.1	1.7	3.3	10.2	65.3	163.8	209.6	2.5	2.9	38.3
CHOUTEAU	6	1	(Z)	.3	(Z)	.1	.2	.5	.5	1.0	(Z)	(Z)	.2
CUSTER*	7	2	.1	.6	.1	.1	.2	.6	1.1	1.7	(Z)	.1	.7
DANIELS*	1	-	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
DAWSON*	12	-	.1	.6	.1	.1	.3	.6	2.1	2.6	(Z)	.1	.6
DEER LODGE	11	4	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	1.1	(D)
FALLON*	3	-	(Z)	(Z)	(Z)	(Z)	(Z)	.1	.1	.2	(Z)	(Z)	.2
FERGUS	12	2	.1	.6	.1	.1	.6	1.4	1.3	2.7	.1	.2	1.9
FLATHEAD	115	27	2.6	16.9	2.2	4.6	13.9	41.8	53.9	97.1	(D)	2.2	26.0
GALLATIN	90	12	.7	4.0	.6	1.1	2.9	8.0	11.1	19.2	.7	.8	9.5
GARFIELD*	1	-	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
GLACIER	7	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(Z)	.1	(D)
GRANITE*	15	2	.1	.3	.1	.1	.3	.6	.9	1.5	(Z)	.1	.6
HILL	16	3	.2	1.4	.1	.2	.6	2.3	6.3	8.7	.1	.1	1.5
JEFFERSON	4	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	.1	(D)
JUDITH BASIN*	2	-	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
LAKE	29	7	.7	3.9	.6	1.3	3.4	6.3	11.1	17.5	.2	.6	6.2
LEWIS AND CLARK	41	11	.7	4.4	.5	.9	2.9	13.6	41.0	48.9	.4	.8	11.3
LIBERTY*	1	-	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
LINCOLN	70	6	1.7	11.2	1.5	3.2	9.6	16.5	18.9	35.1	1.0	1.8	13.3
MCCONE*	1	-	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
MADISON*	2	-	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
MEAGHER*	11	1	.1	.5	.1	.2	.6	1.1	1.4	2.5	.3	.2	1.2
MINERAL	7	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	.2	(D)
MISSOULA	95	28	3.5	22.9	2.9	5.8	17.9	52.7	47.2	98.4	(D)	3.5	30.0
MUSSELSHELL*	8	-	(Z)	.1	(Z)	(Z)	(Z)	.2	.2	.4	(Z)	(Z)	.1
PARK	15	2	.2	.9	.2	.3	.6	1.5	1.7	3.2	.1	.2	2.1
PHILLIPS	3	-	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(Z)	.2
PONDERA*	6	-	(Z)	.1	(Z)	(Z)	.1	.3	.3	.6	(Z)	(Z)	.2
POWDER RIVER*	2	-	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
POWELL	14	3	.2	1.3	.2	.4	1.1	2.2	2.1	4.3	.4	.1	1.7
PRAIRIE	2	-	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
RAVALLI	37	8	.4	2.2	.4	.7	2.0	3.5	5.2	8.3	.3	.4	3.2
RICHLAND	10	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	.2	(D)
ROOSEVELT	8	1	.1	.3	(Z)	.1	.2	.7	3.2	4.0	(D)	.1	1.1
ROSEBUD	9	1	.2	.4	.2	.2	.3	.5	.3	.8	(D)	(Z)	.1
SANDERS	31	5	.5	3.1	.5	1.0	2.8	4.9	11.0	16.0	.3	.5	4.6
SHERIDAN	3	-	(Z)	.1	(Z)	(Z)	.1	.2	.2	.4	(Z)	(Z)	.2
SILVER BOW	42	6	.7	4.6	.5	1.0	3.2	11.5	13.2	24.6	1.3	.8	9.9
STILLWATER	6	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(Z)	.2
SWEET GRASS*	7	-	(Z)	(Z)	(Z)	(Z)	(Z)	.1	.3	.5	(Z)	(Z)	(D)
TETON*	6	-	(Z)	.1	(Z)	(Z)	.1	.2	.2	.5	(Z)	(Z)	(D)
TOOLE	8	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	.1	(D)
TREASURE*	1	-	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
VALLEY*	5	-	(Z)	.1	(Z)	(Z)	.1	.3	.2	.5	-	.1	.7
WHEATLAND*	1	-	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
WIBAUX*	2	-	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
YELLOWSTONE	102	24	2.7	19.3	1.8	3.7	12.0	71.8	180.5	253.9	12.6	2.5	46.3
CITIES WITH 450 OR MORE EMPLOYEES													
BILLINGS	76	18	1.7	10.7	1.0	2.0	5.9	23.4	61.0	84.1	.8	1.3	15.1
GREAT FALLS	30	18	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	1.3	13.1
MISSOULA	47	14	1.5	8.6	1.1	2.2	6.1	19.7	16.4	35.2	.6	1.2	13.9

Note: See descriptions of Standard Metropolitan Statistical Areas at the end of Table 1.

Standard notes: - Represents zero. (D) Withheld to avoid disclosing figures for individual companies. (NA) Not available. (Z) Less than $50 thousand (or under 50 employees).

*For 1967, over 30 percent of the data for this line was estimated.

TABLE 6. RETAIL ESTABLISHMENTS, BY COUNTY

County	Number of Establishments	County	Number of Establishments
Beaverhead	116	Missoula	490
Big Horn	110	Musselshell	62
Blaine	83	Park	169
Broadwater	34	Petroleum	12
Carbon	97	Phillips	82
Carter	23	Pondera	93
Cascade	667	Powder River	26
Choteau	71	Powell	69
Custer	133	Prairie	34
Daniels	54	Ravalli	153
Dawson	126	Richland	109
Deer Lodge	125	Roosevelt	143
Fallon	64	Rosebud	78
Fergus	176	Sanders	79
Flathead	410	Sheridan	82
Gallatir	357	Silver Bow	418
Garfield	27	Stillwater	65
Glacier	141	Sweet Grass	46
Golden Valley	14	Teton	78
Granite	45	Toole	100
Hill	171	Treasure	10
Jefferson	59	Valley	152
Judith Basin	29	Wheatland	49
Lake	170	Wibaux	17
Lewis & Clark	350	Yellowstone	804
Liberty	29		
Lincoln	165	Montana Total	7,454
McCone	32		
Madison	83		
Meagher	32		
Mineral	39		

Source: 1967 Census of Business, Retail Trade, Area Statistics(18)

Average ash and sulfur values were obtained for leading domestic heating coals from Utah (Carbon and Emery Counties) and Wyoming (Rock Springs seams), from the Keystone Coal Buyers Manual(19). Both of these areas produce high-quality coals, low in ash and low in sulfur; the estimated average for coal burned in Montana was taken to be:

4.0% ash
0.8% sulfur
12,500 Btu/lb.

Fuel Apportioning - Oil

Two types of oil are used for fuel, distillate (kerosene, No. 1, No. 2 and No. 4 oils), and residual (basically No. 5 oil and No. 6 oils). The residual oils are too viscous and difficult to handle to be used for residential heating, which is assumed to use distillate exclusively.

Consumption of oil for residential heating can be calculated similarly to the way in which coal consumption was calculated. Oil required per 5-room dwelling unit is 0.18 gal/degree-day(3). For the 28,000 dwelling units estimated to have used oil for heating in 1970, consumption was estimated as follows:

$$28{,}000 \times 8{,}082 \times 0.18 \times \frac{4.3}{5.0} = 35.0 \times 10^6 \text{ gallons/yr}$$

In addition, it is estimated that 250 gallons of oil are used in such households for water heating and cooking(3), giving an additional

$$28{,}000 \times 250 = 7.00 \times 10^6 \text{ gallons/yr.}$$

Total residential oil consumption is then 42.0×10^6 gal/yr.

Distillate oils used for commercial and institutional heating are not tabulated separately, so that these have to be determined by difference.

Oil consumption is reported yearly by the Bureau of Mines; as with coal, latest figures available for Montana are from 1969(20). Category of use is more detailed than for coal; pertinent data from this report are as follows:

Sales of Kerosine and Heating Oils	Thousand Barrels	Gallons
Kerosine, heating	133	5,586,000
Kerosine, other	523	21,966,000
No. 1 Heating oil, automatic burners	89	3,738,000
No. 1 Heating oil, other heating	564	23,688,000
No. 2 Heating oil	544	22,343,000
	1853	77,826,000
No. 5 Heating oil	200	8,400,000
No. 6 Heating oil	26	1,092,000
	226	9,492,000
Sales of Distillate and Residual Oil for Industrial Use		
Distillate	148	6,216,000
Residual	232	9,744,000
	380	15,960,000

Total consumption of distillate for heating, from which oil for residential heating (42.0×10^6 gal) is to be subtracted, is 77.8×10^6 gal; the remainder, to be apportioned over commercial and institutional heating is 35.8×10^6 gal. Both distillate and residual oils were apportioned on the basis of the number of retail establishments, similarly to coal.

Both distillate and residual oils are consumed for industrial purposes; some consumption was identified as point sources. Non-point source consumption was apportioned on an area basis, based on manufacturing employees, as follows:

	Distillate	Residual
Total consumed, gal	6.2×10^6	9.7×10^6
Point source totals, gal	0.7	2.6
Apportioned oil	5.5×10^6	7.1×10^6

Electric utility, oil company, and railroad usage are also separate categories in the Bureau of Mines tabulations, but 1970 figures were available from these users and the 1969 Bureau of Mines data were not used.

On the basis of the sulfur contents of oils reported by point source users, the following values were selected as representative averages for oil consumed in Montana:

	Sulfur, %	Btu/gal
Distillate	0.5%	140,000
Residual	3.0%	150,000

and these values were used throughout.

Fuel Apportioning - Gas

Natural gas consumption figures for 1969 were obtained from the American Gas Association(21).

	Millions of Therms*	Millions of Cubic Feet**
Residential	236.5	23,650
Commercial	155.0	15,500
Industrial	322.1	32,210
	713.6	71.360

---

* Therm = 100,000 Btu

** Assuming an average of 1000 Btu/cu ft.

Residential gas was apportioned on the basis of population; commercial gas, as with coal and oil, was apportioned on the basis of retail establishments. Identified point-source consumption of gas totalled 2542 x 10^6 cu. ft.; the 569 x 10^6 cu. ft. of non-point source industrial gas was apportioned on the basis of manufacturing employees.

Fuel Apportioning - Railroads

Following the merger a few years ago of the Northern Pacific, the Great Northern, and the Chicago, Burlington, and Quincy railroads to form the Burlington Northern, this became the dominant railroad in Montana. Together with the Chicago, Milwaukee, and St. Paul railroad (Milwaukee Road) the two account for probably in excess of 95 percent of the rail trackage in Montana.

Railroads in Montana are characterized by long road mileage, with few large cities and associated yards; Montana tends to be what is known as a "corridor state". Thus, switching does not appear to be a major feature.

Railroad mileage by county was scaled from a railroad map contained in the "Montana Solid Waste Status Report"(22) (Figure 3). Interestingly, there are three counties in the Miles City AQCR with zero railroad trackage. Counties with over 500 manufacturing employees in the 1967 Business Census (18), numbering 10, were assumed to have some sort of yards, and a yard mileage equal to road mileage. Total fuel consumed in Montana in 1970 reported by the two railroads was:

	No. 2 Fuel Oil, Gal.
Burlington Northern	55,082,000
Milwaukee Road	11,390,000
	66,472,000

This was apportioned by counties, in proportion to relative mileage, determined as described above.

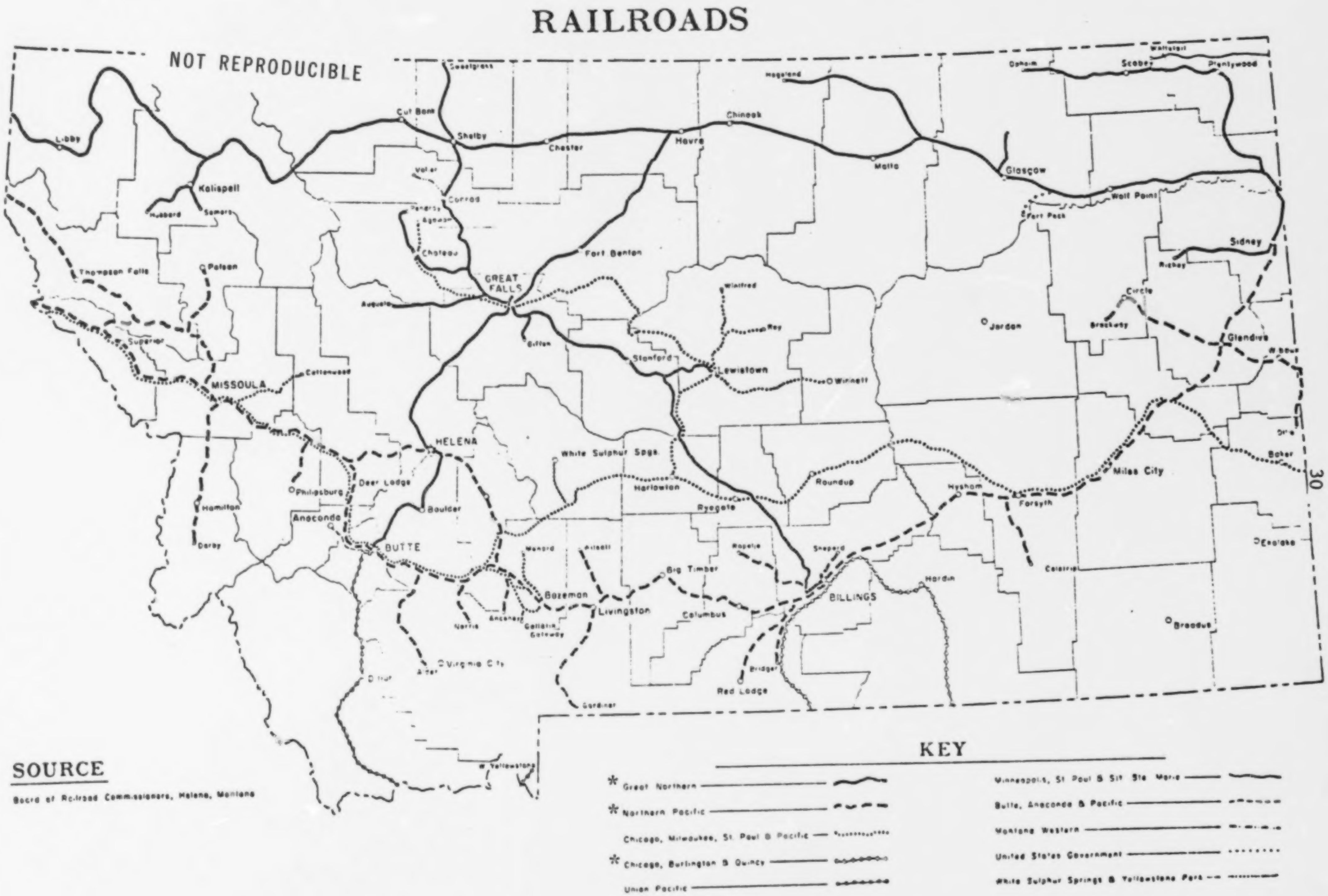

RAILROADS
NOT REPRODUCIBLE
Libby
Kalispell
Hubbard
Somers
Polson
Thompson Falls
Superior
MISSOULA
Cottonwood
Hamilton
Darby
Philipsburg
Deer Lodge
Anaconda
BUTTE
Boulder
HELENA
Augusta
Choteau
Agawam
Power
Conrad
Valier
Cut Bank
Sweetgrass
Shelby
Chester
Havre
Chinook
Hogeland
Malta
Glasgow
Opheim
Scobey
Whitetail
Plentywood
Wolf Point
Fort Peck
Sidney
Richey
Circle
Brockway
Glendive
Wibaux
Jordan
GREAT FALLS
Fort Benton
Gilford
Stanford
Winifred
Roy
Lewistown
Winnett
White Sulphur Spgs.
Harlowton
Roundup
Ryegate
Hysham
Forsyth
Miles City
Colstrip
Ismay
Baker
Ekalaka
Broadus
Hardin
Shepherd
BILLINGS
Bridger
Red Lodge
Rapelje
Columbus
Big Timber
Livingston
Gardiner
Bozeman
Menard
Wilsall
Anceney
Gallatin Gateway
Norris
Virginia City
Alder
Dillon
W. Yellowstone
KEY
* Great Northern
* Northern Pacific
Chicago, Milwaukee, St. Paul & Pacific
* Chicago, Burlington & Quincy
Union Pacific
Minneapolis, St. Paul & Sault Ste. Marie
Butte, Anaconda & Pacific
Montana Western
United States Government
White Sulphur Springs & Yellowstone Park
SOURCE
Board of Railroad Commissioners, Helena, Montana

Figure 4. Railroads in Montana. * Combined into Burlington Northern

Sulfur content was reported to be less than 0.5 percent for all fuel, and normally ranging in the 0.25 - 0.45 percent range. Emission factor used in the computer calculations was supplied by the EPA computer program, and appeared to be based on a sulfur content of 0.5 percent.

Open Burning

No comprehensive records are maintained on the extent to which open burning dumps operate in Montana. Most are in smaller commumities, and there appears generally to be no responsible person in such communities to contact for information. Much reliance was therefore put on estimates, primarily from T. Carmody(23) of the Solid Waste Office of the Montana Board of Health, supplemented by information from the 1970 Solid Waste Status Report(22).

Of the 37 towns and cities in Montana with 1970 populations exceeding 2,000, 25 used land-fill dumps and 12 had open burning dumps (in 1970). The 12 were regarded as large enough to be characterized as point sources, and were so treated. No quantitative data were available on the amounts of materials burned; an estimated value of 5.5 lbs/day/capita was used. This is a lower factor than that generally applicable in the more industrialized sections of the U.S.; the reason appears to be that the waste in Montana towns is primarily domestic wastes. This moderate value is supported by some field tests which have been conducted in Montana(23). Also, industrial wastes gererated in Montana tend to be non-combustible, and are disposed of by the generating establishments individually, and so do not contribute to municipal dumps.

There are some 500 communities in Montana, of which approximately 400 have less than 500 population(23). Essentially all of these have some sort of a disposal ground, often supplemented by burning in backyard barrels. Solid wastes from the balance of the population (excluding the 37 communities above) were considered to be burned in open dumps, using the 5.5 lbs/day/capita factor. Locations were not pin pointed; emissions were treated as an area source in each county.

Considerable pressure is being brought by the state authorities upon open burning dumps, which are prohibited by law (Regulation 90-010). All cities over 4,500 population are required to be in compliance by July 1, 1971, and all cities over 2,500 by July 1, 1972. Progress is being made; of the 12 point-source burning dumps listed in this 1970 inventory, five have already converted to land fill, and two more will convert very soon.

Solvent Evaporation

Evaporation of solvents from all sources except gasoline marketing, e.g., dry cleaning, cleaning of parts, paint coatings, etc., was based directly upon population, using the figure of 30 lbs/yr/capita suggested by The Environmental Protection Agency.

Dry cleaning was initially considered separately, since this category was on the list of sources (April 7, 1971 Federal Register) which should be included as point sources, independent of size. Since they are non-manufacturing operations, they were not listed in the Directory of Manufacturers. A list was prepared from a collection of Montana telephone books, and 130 questionnaires were mailed. Response was 73, of which 62 were usable or applicable. Upon compiling the data it was evident that none qualified as a point source based on the 25 ton/yr minimum emission for hydrocarbon sources.

Accordingly, dry cleaners were discarded as point sources, and this solvent evaporation loss was included in the 30 lbs/yr/capita figure used to calculate area source emissions. (Interestingly, the average emission based on data from those responding was calculated to be 2 lbs/yr per capita in the population served, in good agreement with the 2-2.7 lbs/yr figure in the Emission Inventory handbook).

Motor Vehicles and Gasoline Marketing

Total 1970 automobile and truck registration was supplied by The State Registrar of Motor Vehicles (Table 7). Total gasoline and highway diesel fuel consumption in 1970 was obtained from the state taxing unit, the Montana Board of Equalization:

Table 7. Montana 1970 Motor Vehicle Registration

THIS REPORT COMPILED EACH CALENDAR MONTH AS RATED BY THIS DEPARTMENT. DECEMBER 31, 1970

COUNTY	PASSENGERS	TRUCKS	REGULAR	PERSONAL	COMM	MOTOR CYCLES
	(1)	(2)	(3)	(4)	(5)	(6)
1. Silver Bow	18 700	5 523	1 041	1 438	128	1 552
2. Cascade	38 580	12 521	1 659	3 655	282	2 373
3. Yellowstone	43 650	14 600	2 574	3 104	511	2 749
4. Missoula	27 754	9 626	1 667	2 532	260	2 035
5. Lewis & Clark	16 350	5 813	887	1 677	217	1 407
6. Gallatin	14 189	6 210	1 078	1 360	53	1 574
7. Flathead	17 954	9 565	1 421	2 496	209	1 721
8. Fergus	5 906	3 997	473	476	49	418
9. Powder River	1 341	1 719	220	229	81	116
10. Carbon	3 631	2 571	194	234	73	119
11. Phillips	2 155	1 984	172	137	3	177
12. Hill	7 453	4 414	357	605	90	770
13. Ravalli	6 560	4 177	483	633	111	482
14. Custer	5 790	2 736	324	514	100	433
15. Lake	6 214	3 917	389	628	98	397
16. Dawson	5 110	3 115	242	343	177	444
17. Roosevelt	3 849	3 162	148	395	86	215
18. Beaverhead	3 525	2 330	368	344	59	337
19. Chouteau	3 129	3 736	202	399	49	349
20. Valley	4 888	3 596	210	486	73	304
21. Toole	2 749	2 346	186	302	54	187
22. Big Horn	3 941	3 255	471	443	0	221
23. Musselshell	1 804	1 250	140	131	47	112
24. Blaine	2 403	2 100	155	138	38	152
25. Madison	2 387	1 801	178	205	67	245
26. Pondera	3 024	2 713	303	413	1	323
27. Richland	4 679	3 560	192	368	59	393
28. Powell	3 114	1 540	222	324	64	271
29. Rosebud	2 323	1 669	96	156	62	151
30. Deer Lodge	6 340	2 082	334	526	64	763
31. Teton	2 988	2 984	189	387	96	332
32. Stillwater	2 369	1 829	151	159	55	186
33. Treasure	458	584	30	39	16	34
34. Sheridan	2 986	2 642	149	205	48	229
35. Sanders	3 040	2 240	267	319	3	333
36. Judith Basin	1 386	1 485	110	126	34	112
37. Daniels	1 455	1 650	58	120	25	84
38. Glacier	3 932	2 678	247	400	116	285
39. Fallon	1 977	1 737	259	164	159	111
40. Sweet Grass	1 539	1 121	100	103	28	111
41. McCone	1 248	1 657	114	152	26	123
42. Carter	622	891	75	67	56	31
43. Broadwater	1 231	1 115	93	115	3	83
44. Wheatland	1 235	786	100	93	5	78
45. Prairie	868	835	32	56	20	68
46. Granite	1 354	976	117	136	13	96
47. Meagher	941	783	94	118	26	59
48. Liberty	1 078	1 404	87	120	12	88
49. Park	6 274	2 846	410	543	118	643
50. Garfield	718	876	114	39	3	24
51. Jefferson	2 097	1 256	176	170	0	159
52. Wibaux	704	782	62	50	23	44
53. Golden Valley	451	477	43	38	6	28
54. Mineral	1 148	776	97	90	12	93
55. Petroleum	292	394	41	37	12	37
56. Lincoln	7 391	4 514	532	883	103	616
TOTALS	319 476	166 946	20 333	29 440	4 203	24 881

TOTAL REGISTRATIONS, COLUMN (1) THRU (8). 572 155

*House Trailers included in Column (3).

Gasoline	424,713,950 gal
Diesel fuel	58,810,940 gal

For gasoline motor vehicles, the simplifying assumption was made that travel in urban counties was at an average speed of 25 m.p.h. and in rural counties at 45 m.p.h.; and a county was urban if over 50 percent of the 1970 population resided in urban areas (See Table 3).

A combination of Bureau of Mines and Montana data was used for diesel fuel consumption. Montana taxes and tabulates diesel fuel only when used on highways, and exercises no surveillance for diesel fuel used off-highway or for other purposes. Consumption on the highways was 58.8×10^6 gal in 1970. In 1969 the Bureau of Mines data indicated 15.5×10^6 gal were used off-highway plus 9.4×10^6 for "other" uses. As an example of off-highway use, 7.5×10^6 gal were consumed in 1970 in Anaconda's huge Berkely open-pit mine, which was considered a point source. No doubt large quantities were also consumed in diesel-powered logging, farming, and oil-well drilling equipment. Total diesel fuel apportioned (excluding the 7.5×10^6 gal point source) was 76.2×10^6 gal. No more suitable apportioning basis for the off-highway use than number of trucks was found, so the total diesel fuel usage was assumed to be proportional to the number of trucks registered in each county (Table 7).

Liquified petroleum gas (LPG) is a very minor highway fuel in Montana, 672,500 gallons in 1970, (only 0.14 percent of total automotive fuel) and was neglected.

Solvent emissions from gasoline marketing were apportioned on the same basis as automobile travel, i.e., gallons/county, proportional to automobile registrations. An emission factor of 21 lbs per 1000 gallons marketed taken from McGraw and Duprey(4), was used.

Grain Elevators

Grain elevators are an emission category which, strictly speaking, should be treated as point sources. Because there were no adequate data on individual elevators, it appeared advisable to combine the numerous small rural elevators and to calculate their emissions as area sources.

Montana is a major grain producing state (85,000,000 bu. of wheat and 65,000,000 bu. of barley in 1970), and there are some 330 licensed grain dealers and warehousemen. A list of these was obtained from the State Department of Agriculture(24) after the mailing of the questionnaires. As a result, only a fraction of the elevators were canvassed. However, the results indicated little or no significant effect because the coverage was fractional. Though the reasons are not wholly understood, it appears that secrecy regarding their operations is almost a fetish among those persons in the grain-handling business, and information supplied was meager. As an example of this attitude, before similar data could be obtained for a recent Montana State Department of Agriculture research study, an agreement was necessary that the data would all be coded and treated strictly confidentially(25). Due to this attitude, as well as to the incomplete coverage of the questionnaires, the data acquired were not adequate to treat elevators as point sources. A scheme for estimating elevator tonnages was devised. The catalog of elevators mentioned above(24) tabulated the bushel capacity of each elevator, and from this the total capacity in each county and each region could be summed. Data were available on 1970 wheat production by county (but not for barley)(26). Barley production was assumed on the basis of data from previous years(27) to be proportional to wheat production. Grain handled in elevators in each county was assumed to be in the same proportion to total regional production as was the county elevator capacity to total regional capacity. From these calculations an average value for grain for each county was derived. Most of the elevators in question perform a minimum of operations on the grain; the emission factor selected to represent these conditions was 10 lbs/ton.

The chief emission of grain elevators is particulate matter, and fugitive dust causes occasional local problems. Most such elevators are located in rural or semi-rural areas, so that the number of persons affected is moderate. Also, they tend to be found in the flatter eastern half of the state, where the ventilation is better, rather than in the valleys of the more mountainous western half, which helps to minimize air quality problems.

The large central terminal elevators and flour or feed mills, of which there are several in Montana, supplied sufficient information that they could be treated as point sources.

Asphalt Batching Plants

Asphalt batching plants are not considered manufacturers by the standards of the Directory of Manufacturers, and none were listed. However, according to Montana regulations, each asphalt batching plant requires a permit from the APC office of the Montana State Board of Health in order to operate, so that an accurate listing of batching plants is maintained by the APC office. Questionnaires were sent to all on this list. Upon study of the returned questionnaires it became evident that due to their transient nature, it was more practical in Montana to treat these as area sources, for purposes of an inventory of air pollutants. These plants, almost all of which are portable or transportable, are normally set up in the particular rural area where road paving is scheduled, and remain there until that stretch of paving is completed. Upon completion of the job they are moved to the next site, possibly many miles distant. A batch plant unit might have worked in three or four different counties during 1970, and a number of them did. Also, their exact locations were generally not defined in the questionnaire responses, so that location of them as point sources was hardly possible. Considering these factors, plus the fact that they do not rank particularly high on the list of pollutants adversely affecting the overall Montana air quality, they lent themselves better to an area-source treatment.

Their chief emission is particulate matter, and fugitive dust can be a troublesome local problem if a batching plant is not properly operated. However, the Montana APC authorities are rapidly cognizant of such situations, and dispose of them as they occur.

Tons of asphalt laid down in each county by each asphalt batching plant operator was obtained from the questionnaires, or through telephone follow-up, and the county totals summed. No further apportioning was necessary; each county was assigned the total production of that county.

Aircraft

The Federal Aviation Administration (FAA) maintains a record of commercial air travel, and issues each year a report which compiles, among other things, the number of departures at each airport by commercial air carriers, by type of plane. The latest such report currently available, that for 1969 (28), was used in calculating aircraft emissions.

In addition to the data contained in the FAA report on commercial air carriers, estimates were supplied by the regional FAA office in Denver, Colorado, for military and general aviation operations at the principal air fields in Montana. Estimates were obtained from the U.S. Air Force (29) on operations at Malmstrom AFB, the only military airfield in Montana.

With its small population and few metropolitan areas, the number of major airports in Montana is few. Emissions from airports with less than two commercial flights a day were neglected; this left 7 airports.

Since emissions are defined as those occurring up to the 3,500-ft level during take-off and landing, the area involved was regarded as too broad to be considered as a point source. Emissions were, therefore, treated as area sources in the county in which the airport was located.

Slash Burning

Slash burning is one of the largest and most difficult air pollution problems facing the State of Montana. In the process of lumbering, much brush is inevitably left in the forest after the log is taken out. Left untouched, this gives rise to a serious fire hazard; and may serve as a host for destructive insects, jeopardizing the health of the remaining standing timber. Present technology for disposing of this waste, known as slash, is to pile it up in large piles and to burn it when the weather is favorable, which is generally in the early fall months, August through November. Unfortunately, this is also the period of the year when temperature inversions are most prevalent, particularly in the poorly ventilated valleys in the western portions of the state where most of the timber is found, and where most of the slash burning originates. The enormous scale on which slash is burned, thousands of acres annually, creates a serious air pollution problem during this season of the year.

Defining the emission sources and quantifying the emissions from slash burning is a difficult problem. The major burning of slash occurs as a result of lumbering operations in National Forests, and is monitored by the U. S. Forest Service. By arrangement with the U. S. Forest Service, the location of each burning of slash in National Forests during 1970 was reported to the Montana Air Pollution Control Office, and its location noted on a large state map with colored pins. These pins were counted for this survey and the percentage in each AQCR was determined, as follows:

Percentage	AQCR
74	Missoula
17	Helena
7	Billings
2	Great Falls
0	Miles City
100	

Apportioning to the individual counties in each region was based on the proportion of national forest acreage in each county of the total in the region, taken from The Montana Data Book (30), and shown in Table 8.

Slash data were supplied by W. R. Moore, Chief of the Division of Fire Control of Region 1, U. S. Forest Service (31), as follows:

Slash created, 1970	59,904 acres
Slash burned, 1970	32,518 acres

Slash burning on state and private lands is under the supervision of the state, for which data were supplied by R. B. Griffes, Chief of The Division of Forest Management (32). State slash records are on the basis of board feet cut per county rather than on acres, so another conversion factor is necessary. The state and private acreage was computed by ratioing the areas to national forest acreage on the basis of the relative timber harvests for 1969, taken from The Montana Data Book (30):

Table 8. STATE AND NATIONAL FOREST ACREAGE, MONTANA, BY COUNTY, 1970

County	State Forests		National Forests		Total State and National Forests	
	Acres	Percent of County	Acres	Percent of County	Acres	Percent of County
State, total	486,412	0.5	16,674,914	17.9	17,161,326	18.4
Beaverhead	3,844	0.1	1,367,188	38.4	1,371,032	38.6
Broadwater	-	-	178,008	23.2	178,008	23.2
Carbon	-	-	319,836	24.1	319,836	24.1
Carter	-	-	89,400	4.2	89,400	4.2
Cascade	2,013	0.1	177,262	10.4	179,275	10.5
Chouteau	-	-	31,979	1.3	31,979	1.3
Deer Lodge	640	0.1	153,033	32.4	153,673	32.5
Fergus	-	-	92,704	3.4	92,704	3.4
Flathead	129,550	3.9	1,783,920	54.2	1,913,470	58.2
Gallatin	6,428	0.4	583,319	36.2	589,747	36.6
Glacier	-	-	25,304	1.3	25,304	1.3
Golden Valley	-	-	23,644	3.1	23,644	3.1
Granite	6,531	0.6	660,615	59.6	667,146	60.2
Jefferson	464	(a)	463,889	43.9	464,353	43.9
Judith Basin	-	-	292,841	24.3	292,841	24.3
Lake	52,771	5.5	153,704	16.0	206,475	21.5
Lewis & Clark	27,024	1.2	991,932	44.7	1,018,956	45.9
Lincoln	60,599	2.5	1,754,640	73.8	1,815,239	76.3
Madison	700	(a)	800,119	35.4	800,819	35.4
Meagher	-	-	441,428	29.3	441,428	29.3
Mineral	21,747	2.8	646,890	82.6	668,637	85.4
Missoula	63,259	3.8	688,686	41.2	751,945	45.0
Musselshell	17,865	1.5			17,865	1.5
Park	-	-	795,087	47.3	795,087	47.3
Pondera	-	-	106,637	10.1	106,637	10.1
Powder River	-	-	341,946	16.3	341,946	16.3
Powell	17,061	1.1	634,952	42.5	652,013	43.6
Ravalli	22,799	1.5	1,109,580	72.7	1,132,379	74.2
Rosebud	-	-	95,827	3.0	95,827	3.0
Sanders	52,642	2.9	908,921	50.7	961,563	53.7
Silver Bow	475	0.1	193,014	42.1	193,489	42.2
Stillwater	-	-	185,166	16.1	185,166	16.1
Sweet Grass	-	-	282,063	23.9	282,063	23.9
Teton	-	-	235,264	16.0	235,264	16.0
Wheatland	-	-	66,116	7.3	66,116	7.3

Source: Montana Office of the State Forester, *Classified State Forest Lands Ownership List* and U. S. Forest Service, *Forest Service News*, Sept. 3, 1970.

(a) Less than one tenth of one percent

TIMBER HARVEST[1], BY OWNERSHIP, MONTANA, 1969

Item	Volume, Thousands of board feet	Percent of total
Total, all ownerships	1,335,885	100.0
Federally-owned land	888,885	66.5
U.S. Forest Service	700,685	59.9
U.S. Bureau of Indian Affairs	72,700	5.4
U.S. Bureau of Land Management	16,500	1.2
State of Montana	43,000	3.2
Private	404,000	30.2

Source: U.S. Dept. of Agriculture, Forest Service, Region 1, Missoula, Montana, unpublished data.

[1] Includes sawlog, pulpwood, and products (poles, posts, fuelwood, etc.) volume.

On this basis, there was about 0.04 acres of slash burned per thousand board feet of U.S. Forest Service timber cut; proportionally there would have been about 15,070 acres from the 369,000 MBF of state and private sawtimber cut in 1970. Acreage per county was calculated by multiplying the conversion factor by the total board feet cut in that county.

Another major source of slash burning in 1970 was that done by the U.S. Army Corps of Engineers in connection with the clearing out of the reservoir area behind the under-construction Libby Dam on the Kootenai River. This was reported to be about 15,100 acres by the Corps of Engineers (33), all in Lincoln County.

The U.S. Bureau of Indian Affairs conducts some timber operations and does a minor amount of slash burning. This was estimated (34) to be not over 1,500 acres in 1970, almost entirely in Flathead County, where 95 percent of their operations occur. In addition, they recorded 470 acres of wildfire.

The U.S. Bureau of Reclamation indicated (35) that they conducted essentially no slash burning in Montana in 1970. They do some "sweeping" of reservoirs for floating driftwood which is dragged out, piled up to dry, and then burned, but indicated that this activity was minor in 1970, and could give no estimate.

Similarly, the U.S. Bureau of Land Management indicated a negligible amount of slash burning in Montana in 1970, less than 500 acres, probably much less, since only 14,000 M board feet were cut. According to Mr. H. Lynd(36), this agency is moving towards a spread out and rot away technique, and is getting away from slash burning as much as possible. Their contribution was neglected in the estimate.

Estimated acreage of wildfires in 1970 was estimated at about 13,100 acres on U.S. Forest Service lands and about 16,000 acres on state and private lands. Wildfires were apportioned on the basis of forest acreage in each county.

One of the most difficult problems in quantifying slash burning and wildfires was in converting areas to masses. There is a good deal of variability in slash generated per acre, depending on the topography, the type of timber, and on whether the selective or clear cutting approach is followed. The U.S. Forest Service has characterized (37) slash as follows:

	Tons available fuel per acre
Low volume slash	< 75
Medium volume slash	75-150
High volume slash	> 150

An average value of 125 tons/acre was selected for calculating emissions from slash burning. More or less empirically, a figure twice this, 250 tons/acre, was selected for wildfires. More research seems to be needed in this area, to better define the ratio of slash to saw timber yields, of tons fuel burned per acre, and in pollutants emitted.

Agricultural Burning

Two types of agricultural burning are carried on in Montana. Perhaps most important, in view of the approximately 3-1/2 million acres seeded to wheat in Montana in 1970, is stubble burning. R. W. Boubel of the Oregon State University, cited earlier for work on emissions from tepee burners, has also investigated field burning (38), and determined emission factors. Although the tons of fuel per acre is, like any agricultural crop, quite variable from area to area, and from year to year, the range is from 2-5 tons/acre, and Boubel suggests 2.5 tons/acre as a good average figure.(39)

While the percentage of field burning is presently low, it appears to have passed through a low point and is again on the increase, as the belief spreads that yields are increased by burning. As related by Boubel, since the straw is primarily cellulosic, and diverts fertilizer for its decomposition, field burning promotes more efficient fertilizer usage in crop growing. He notes increasing field burning in Oregon over the past few years. As a further example, he indicated that in the province of Alberta 500,000 acres of wheat fields are expected to be burnt this year. Thus, this could well be an air pollution problem of increasing future significance in Montana.

Based on estimates of several persons familiar with the agricultural picture, the value selected for agricultural burning was 1 percent of the 1970 wheat acreage in each county. At 2.5 tons/acre, the factor for fuel burned per acre was then 0.025 tons/acre. Wheat acreage was obtained from the "1970 Montana Wheat Estimated by Counties",(26) issued by the USDA Statistical Reporting Service in Helena. Total tonnage of stubble distributed over the counties was 87,500 tons.

The other type of agricultural burning practiced in Montana is irrigation ditch burning, to clear out grass and weeds so as to permit unimpeded water flow. This is a difficult figure to quantify, since no detailed records are available. Based on information from H. E. Aldrich (40) the U. S. Bureau of Reclamation has constructed about 2,280 miles of canals and laterals in Montana. Normally, some spring burning is required each year to burn blow-weeds and trash collected in the water prism. Except for the water prism, the entire canal right-of-way is seeded to grass; this is not burned. They estimated fuel burned at 0.5 ton/mile.

According to the Montana Water Resources Board(41), the Bureau of Reclamation canals are but a small part of the total in Montana. Their estimate for Montana is 32,000 miles of main ditches, with a mileage of lateral ditches of five times this or 160,000 miles. Only a small portion of main ditches, many of which are concrete lined, is burned. The irrigation system is spread out over almost the entire state, with the exception of some of the timber country, and the dry-land farming section in the eastern part. An accurate determination of the miles of irrigation ditch in each county, while possible, would have required efforts beyond the scope of this emission inventory, and was not attempted. Instead, a reasonable approximation was made, based on the available information.

The Bureau of Reclamation figure of 0.5 ton/mile was judged to be on the low side. If a 2.5 ft bank is assumed on each side of the water prism of the ditch, the total area is very close to 0.6 acre/mi. At the previously assumed value of 2.5 tons/acre, the fuel available is 1.5 tons/mi. If it is assumed that burning is restricted principally to the 160,000 mi of laterals, and that no more than one-third are burned each year, total tonnage burned annually is 80,000 tons.

Allocation of this 80,000 tons to counties was made by eliminating counties whose average 1970 wheat yield was less than 20.0 bu/acre, and, hence, presumably not irrigated, since the average state wide yield was 25.2 bu/acre (and counties like Beaverhead, Gallatin and Flathead had yields in the 35-50 bu/acre range). This eliminated 12 counties; four more minor wheat producing counties with less than 1,000 acres in wheat were also eliminated. This left 40 counties, and the 80,000 tons was spread uniformly over these 40, at an average of 2,000 tons/county.

RESULTS

The detailed results of The Montana Emission Inventory are contained in the computer printouts in Volume II. Each state's Implementation Plan is to contain a summary of emission levels expected to result from the application of the control strategy in a table similar to that of Appendix D in the August 14, 1971, Federal Register. Accordingly, the same general format was adopted for presenting existing emissions.

Emissions were summed under the following principal categories:

I. Fuel Combustion
    Residential
    Commercial, Institutional and Industrial
    Steam-Electric Power Plants
II. Process Losses
III. Solid Waste Disposal
IV. Transportation
V. Miscellaneous Sources

A number of categories in the suggested format which are not applicable to Montana were omitted for the sake of clarity and simplification. Among these were the following:

Residential fuels - Wood and other

Although minor quantities of wood and LPG are used in Montana, accurate data were not available, and these categories were omitted.

Commercial, and Industrial Fuels - Coke, Wood and Other.

Quantities of these fuels burned in these categories appeared to be even less significant than for residential fuel, and were neglected.

Solid Waste Disposal - Incineration

No municipal incinerators were identified in Montana. Small incinerators, such as those used for stores and apartments, etc., are too small to qualify as point sources; additionally, there was insufficient information on these to permit compilation of emission inventory data.

Solid Waste Disposal - Open Burning on Site

No data are available in this category, which is believed to be insignificant in Montana.

Transportation - Vessels

This does not apply to Montana.

Summary of Fuel Use and Emissions by Region

Emissions are summarized for the various source categories for particulates, SO_2, CO, HC, and NO_x for each air quality control region in Montana in Tables 9 to 13. Emissions are summed for both point sources and area sources, which are combined for the grand total for the AQCR.

The emissions shown were derived from the detailed point and area source tabulations and county summaries contained in Volume II. The totals are representative of emissions as of 1970, which are neither wholly controlled or uncontrolled. However, data are presented in the detailed printouts on what emissions would be in the absence of any controls, as well as what they would be under state and federal regulations.

A condensed summary of Tables 9 to 13 is presented in Table 14, which compares emissions from the five AQCR's by principal category. The nature of the problem in Montana is evident here. There are high particulate emissions in AQCR 142 (smelters) and AQCR 144 (slash burning and wildfires primarily). Huge emissions of sulfur dioxide occur in AQCR 142 (smelters) and moderate emissions in AQCR 140 (refineries and central power stations). CO emissions are more uniform across the regions, reflecting the fact that this pollutant originates primarily from vehicular

TABLE 9. EMISSIONS INVENTORY SUMMARY

Air Quality Control Region Billings (140)

Data Representative of Calendar Year 1970

SOURCE CATEGORY	TONS OF POLLUTANT/YEAR					FUEL, ETC.	
	Part.	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. Residential Fuel-Area Source							
1. Bituminous Coal	65	247	406	97	41	16,248	Tons
2. Distillate Oil	41	295	20	12	49	8,181	M gal
3. Natural Gas	44	1	46	18	173	4,607	MMcu ft
4. TOTAL	150	543	472	127	263	--	
B. Comm. - Instl. & Ind.							
1.a. (Bituminous) Coal-Area Source	84	127	209	50	21	9,592	Tons
b. (Bituminous) Coal-Point Source	467	1,544	27	14	205	27,300	Tons
2.a. Distillate Oil-Area Source	60	284	1	12	237	7,908	M gal
b. Distillate Oil-Point Source	-	-	-	-	-	-	
3.a. Residual Oil-Area Source	34	717	0	5	90	3,005	M gal
b. Residual Oil-Point Source	455	11,639	4	59	1,187	39,556	M gal
4.a. Natural Gas-Area Source	37	1	30	30	193	3,951	MMcu ft
b. Natural Gas-Point Source	12	3	2	132	302	2,775	MMcu ft
5.a. Process Gas-Point Source	143	1,326	37	665	2,886	11,182	MMcu ft
6. TOTAL	1,292	15,641	310	967	5,121	-	
C. Steam-Electric Power Plant							
1. Bituminous Coal	1,025	9,188	202	60	3,627	403,000	Tons
2. Distillate Oil	-	-	-	-	-	-	
3. Residual Oil	6	165	0	3	55	1,040	M gal
4. Natural Gas	19	1	0	49	481	2,469	MMcu ft
5. TOTAL	1,050	9,354	202	112	4,163	-	
D. TOTAL FUEL COMBUSTION	2,492	25,538	984	1,206	9,347		
II. PROCESS LOSSES							
A. Area Sources(1)	2,490	-	-	2,029	-	-	
B. Point Sources	849	4,246	37,000	20,021	373	-	
III. SOLID WASTE DISPOSAL							
A. Open Burning							
1.a. Dumps-Area Source	436	27	2,315	817	163	54,477	Tons
b. Dumps-Point Source	35	2	105	35	9	3,504	Tons
B. Other							
1. Slash burning-Area Source	2,460	-	7,238	580	290	289,500	Tons
2. Teepees-Point Source	14	-	48	6	1	745	Tons
C. TOTAL SOLID WASTE DISPOSAL	2,945	29	9,706	1,438	463	348,226	Tons
IV. TRANSPORTATION-AREA SOURCE							
A. Motor Vehicles							
1. Gasoline	363	220	130,009	17,689	10,743	88,015	M gal
2. Diesel	181	326	2,355	471	2,464	14,493	M gal
B. Off-highway Fuel Usage	-	-	-	-	-	-	
C. Aircraft	114	89	571	440	103	-	
D. Railroad	172	447	481	343	515	13,739	M gal
E. Gasoline Hndlg. Evap. Losses	-	-	-	924	-	88,015	M gal
F. TOTAL TRANSPORTATION	830	1,082	133,416	19,867	13,825		
V. MISCELLANEOUS-AREA SOURCE							
A. Agricultural Burning	224	-	1,350	270	27	27,466	Tons
B. Forest Wildfires	3,970	-	11,675	937	467	467,000	Tons
C. TOTAL MISCELLANEOUS	4,194	-	13,025	1,207	494	494,466	Tons
VI. GRAND TOTAL							
A. Area Source	10,775	2,781	156,706	24,725	15,576		
B. Point Source	3,025	28,114	37,425	21,044	9,126		
C. TOTAL	13,800	30,895	194,131	45,769	24,702		

(1) Includes particulates from grain elevators and asphalt batching plants and hydrocarbons from solvent evaporation.

TABLE 10. EMISSIONS INVENTORY SUMMARY

Air Quality Control Region Great Falls (141)

Data Representative of Calendar Year 1970

SOURCE CATEGORY	TONS OF POLLUTANT/YEAR					FUEL, ETC.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. Residential Fuel-Area Source							
1. Bituminous Coal	69	263	433	104	43	17,305	Tons
2. Distillate Oil	44	314	22	13	52	8,715	M gal
3. Natural Gas	47	1	49	20	184	4,907	MM cu f
4. TOTAL	160	578	504	137	279	-	
B. Comm. - Instl. & Ind.							
1.a. (Bituminous) Coal-Area Source	112	141	206	50	193	9,329	Tons
b. (Bituminous) Coal-Point Source						-	
2.a. Distillate Oil-Area Source	58	277	1	11	231	7,693	M gal
b. Distillate Oil-Point Source						-	
3.a. Residual Oil-Area Source	33	689	-	5	87	2,887	M gal
b. Residual Oil-Point Source	16	330	-	2	43	1,430	M gal
4.a. Natural Gas-Area Source	36	1	30	29	186	3,824	M cu ft
b. Natural Gas-Point Source	16	-	-	1	1	3,184	MM cu f
5.a. Process Gas-Point Source	-	2,702	-	84	796	1,830	MM cu f
6. TOTAL	431	4,140	237	182	1,537	-	
C. Steam-Electric Power Plant							
1. Bituminous Coal							
2. Distillate Oil							
3. Residual Oil							
4. Natural Gas							
5. TOTAL	-	-	-	-	-	-	
D. TOTAL FUEL COMBUSTION	591	4,718	741	319	1,816		
II. PROCESS LOSSES							
A. Area Sources(1)	8,874	-	-	2,161	-	-	
B. Point Sources	235	36,163	4,589	3,691	36	-	
III. SOLID WASTE DISPOSAL							
A. Open Burning							
1.a. Dumps-Area Source	569	36	3,021	1,066	213	71,074	Tons
b. Dumps-Point Source	631	63	1,893	631	157	63,116	Tons
B. Other							
1. Slash burning-Area Source	705	-	2,076	166	84	83,000	Tons
2. Teepees-Point Source	33	1	610	52	5	93,000	Tons
C. TOTAL SOLID WASTE DISPOSAL	1,938	100	7,600	1,915	459	226,490	Tons
IV. TRANSPORTATION-AREA SOURCE							
A. Motor Vehicles							
1. Gasoline	359	217	128,186	17,444	10,605	86,858	M gal
2. Diesel	199	358	2,587	517	2,707	15,923	M gal
B. Off-highway Fuel Usage	-	-	-	-	-	-	
C. Aircraft	152	85	587	392	111	-	
D. Railroad	135	351	378	270	405	10,802	M gal
E. Gasoline Hndlg. Evap. Losses	-	-	-	912	-	86,858	M gal
F. TOTAL TRANSPORTATION	845	1,011	131,738	19,535	13,828	-	
V. MISCELLANEOUS-AREA SOURCE							
A. Agricultural Burning	443	-	2,620	524	52	52,350	Tons
B. Forest Wildfires	1,721	-	5,057	405	203	202,250	Tons
C. TOTAL MISCELLANEOUS	2,164	-	7,677	929	255	254,600	Tons
VI. GRAND TOTAL							
A. Area Source	13,556	2,733	145,253	24,039	15,356	-	
B. Point Source	931	39,259	7,092	4,461	1,038	-	
C. TOTAL	14,487	41,992	152,345	28,550	16,394	-	

(1) Includes particulates from grain elevators and asphalt batching plants and hydrocarbons from solvent evaporation.

TABLE 11. EMISSIONS INVENTORY SUMMARY

Air Quality Control Region Helena (142)

Data Representative of Calendar Year 1970

SOURCE CATEGORY	TONS OF POLLUTANT/YEAR					FUEL, ETC.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. Residential Fuel-Area Source							
1. Bituminous Coal	80	305	502	120	50	20,070	Tons
2. Distillate Oil	51	364	25	15	61	10,107	M gal
3. Natural Gas	54	2	57	23	213	5,692	MM cu ft
4. TOTAL	185	671	584	158	324	-	
B. Comm. - Instl. & Ind.							
1.a. (Bituminous) Coal-Area Source	136	178	266	65	36	11,758	Tons
b. (Bituminous) Coal-Point Source	45	680	45	25	340	45,000	Tons
2.a. Distillate Oil-Area Source	73	350	1	5	292	9,738	M gal
b. Distillate Oil-Point Source	-	1	-	-	1	7,735	M gal
3.a. Residual Oil-Area Source	39	818	0	6	103	3,427	M gal
b. Residual Oil-Point Source	-	-	-	-	-	-	
4.a. Natural Gas-Area Source	45	1	39	32	219	4,705	MM cu ft
b. Natural Gas-Point Source	122	5	4	263	1,308	15,060	MM cu ft
5.a. Process Gas-Point Source	-	-	-	-	-	-	
6. TOTAL	460	2,033	355	396	2,299	-	
C. Steam-Electric Power Plant							
1. Bituminous Coal							
2. Distillate Oil							
3. Residual Oil							
4. Natural Gas							
5. TOTAL	-	-	-	-	-	-	
D. TOTAL FUEL COMBUSTION	645	2,704	939	554	2,623		
II. PROCESS LOSSES							
A. Area Sources[(1)]	979	-	-	2,507	-	-	
B. Point Sources	66,798	329,195	-	488	-	-	
III. SOLID WASTE DISPOSAL							
A. Open Burning							
1.a. Dumps-Area Source	617	39	3,277	1,157	231	77,112	Tons
b. Dumps-Point Source	144	14	446	147	36	14,523	Tons
B. Other							
1. Slash burning-Area Source	10,341	-	30,415	2,436	1,216	1,216,625	Tons
2. Teepees-Point Source	672	10	12,450	1,054	106	186,830	Tons
C. TOTAL SOLID WASTE DISPOSAL	11,774	63	46,588	4,794	1,589	1,495,090	Tons
IV. TRANSPORTATION-AREA SOURCE							
A. Motor Vehicles							
1. Gasoline	420	255	160,489	21,569	12,106	101,703	M gal
2. Diesel	184	331	2,393	479	2,504	14,727	M gal
B. Off-highway Fuel Usage							
C. Aircraft	86	45	269	255	145	-	
D. Railroad	185	481	518	370	555	14,811	M gal
E. Gasoline Hndlg. Evap. Losses	-	-	-	1,068	-	101,703	M gal
F. TOTAL TRANSPORTATION	875	1,112	163,669	23,741	15,310	-	
V. MISCELLANEOUS-AREA SOURCE							
A. Agricultural Burning	230	-	1,345	269	25	26,995	Tons
B. Forest Wildfires	19,556	-	57,519	4,605	2,243	2,300,750	Tons
C. TOTAL MISCELLANEOUS	19,786	-	58,864	4,874	2,268	2,327,745	Tons
VI. GRAND TOTAL							
A. Area Source	33,076	3,169	257,115	34,981	19,999	-	
B. Point Source	67,781	329,905	12,945	1,977	1,791	-	
C. TOTAL	100,857	333,074	270,060	36,958	21,790	-	

---

(1) Includes particulates from grain elevators and asphalt batching plants and hydrocarbons from solvent evaporation.

TABLE 12. EMISSIONS INVENTORY SUMMARY

Air Quality Control Region Miles City (143)

Data Representative of Calendar Year 1970

SOURCE CATEGORY	TONS OF POLLUTANT/YEAR					FUEL, ETC.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. Residential Fuel-Area Source							
1. Bituminous Coal	45	170	280	67	28	11,197	Tons
2. Distillate Oil	28	203	14	8	34	5,640	M gal
3. Natural Gas	30	1	32	13	119	3,175	MM cu ft
4. TOTAL	103	374	326	88	181	--	
B. Comm. - Instl. & Ind.							
1.a. (Bituminous) Coal-Area Source	73	107	171	41	19	7,035	Tons
b. (Bituminous) Coal-Point Source						--	
2.a. Distillate Oil-Area Source	44	212	1	9	177	5,891	M gal
b. Distillate Oil-Point Source	4	18	--	1	15	500	M gal
3.a. Residual Oil-Area Source	19	410	--	2	52	1,717	M gal
b. Residual Oil-Point Source	22	260	--	3	57	1,910	M gal
4.a. Natural Gas-Area Source	25	1	25	13	107	2,639	MM cu ft
b. Natural Gas-Point Source	18	1	--	453	2,173	3,147	MM cu ft
5.a. Process Gas-Point Source	1	1	--	2	10	108	MM cu ft
6. TOTAL	206	1,010	197	524	2,610	--	
C. Steam-Electric Power Plant							
1. Bituminous Coal	3,007	4,264	160	48	2,885	320,593	Tons
2. Distillate Oil						--	
3. Residual Oil						--	
4. Natural Gas	--	--	--	2	18	96	MM cu ft
5. TOTAL	3,007	4,264	160	50	2,903	--	
D. TOTAL FUEL COMBUSTION	3,316	5,648	683	662	5,694	--	
II. PROCESS LOSSES							
A. Area Sources (1)	8,096	--	--	1,398	--	--	
B. Point Sources	325	--	--	210	--	--	
III. SOLID WASTE DISPOSAL							
A. Open Burning							
1.a. Dumps-Area Source	454	28	2,411	851	170	56,734	Tons
b. Dumps-Point Source	123	13	367	123	32	12,396	Tons
B. Other							
1. Slash burning-Area Source						--	
2. Teepees-Point Source	42	1	780	65	6	12,000	Tons
C. TOTAL SOLID WASTE DISPOSAL	619	42	3,558	1,039	208	81,130	Tons
IV. TRANSPORTATION-AREA SOURCE							
A. Motor Vehicles							
1. Gasoline	227	138	64,705	9,235	7,210	55,000	M gal
2. Diesel	189	341	2,461	492	2,575	15,147	M gal
B. Off-highway Fuel Usage						--	
C. Aircraft						--	
D. Railroad	147	383	413	295	442	11,798	M gal
E. Gasoline Hndlg. Evap. Losses	--	--	--	578	--	55,000	M gal
F. TOTAL TRANSPORTATION	563	862	67,579	9,600	10,227	--	
V. MISCELLANEOUS-AREA SOURCE							
A. Agricultural Burning	602	--	3,180	638	62	58,952	Tons
B. Forest Wildfires	1,067	--	3,138	252	126	125,500	Tons
C. TOTAL MISCELLANEOUS	1,669	--	6,318	890	188	184,452	Tons
VI. GRAND TOTAL							
A. Area Source	11,046	1,954	76,831	12,892	11,131	--	
B. Point Source	3,542	4,558	1,307	907	5,186	--	
C. TOTAL	14,588	6,512	78,138	13,799	16,317	--	

---

(1) Includes particulates from grain elevators and asphalt batching plants and hydrocarbons from solvent evaporation.

TABLE 13. EMISSIONS INVENTORY SUMMARY

Air Quality Control Region Missoula (144)

Data Representative of Calendar Year 1970

SOURCE CATEGORY	TONS OF POLLUTANT/YEAR					FUEL, ETC.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. Residential Fuel-Area Source							
1. Bituminous Coal	74	282	465	111	46	18,580	Tons
2. Distillate Oil	47	337	23	14	56	9,357	M gal
3. Natural Gas	50	2	53	21	198	5,269	MM cu ft
4. TOTAL	171	621	541	146	300	--	
B. Comm. - Instl. & Ind.							
1.a. (Bituminous) Coal-Area Source	189	191	219	54	52	12,587	Tons
b. (Bituminous) Coal-Point Source						--	
2.a. Distillate Oil-Area Source	75	362	1	15	302	10,066	M gal
b. Distillate Oil-Point Source						--	
3.a. Residual Oil-Area Source	63	1,340	--	9	169	5,620	M gal
b. Residual Oil-Point Source	12	232	--	2	32	1,080	M gal
4.a. Natural Gas-Area Source	56	2	32	72	374	6,072	MM cu ft
b. Natural Gas-Point Source	--	1	1	54	235	2,687	MM cu ft
5.a. Process Gas-Point Source						--	
6. TOTAL	395	2,128	253	206	1,164	--	
C. Steam-Electric Power Plant							
1. Bituminous Coal							
2. Distillate Oil							
3. Residual Oil							
4. Natural Gas							
5. TOTAL	--	--	--	--	--	--	
D. TOTAL FUEL COMBUSTION	566	2,749	794	352	1,464		
II. PROCESS LOSSES							
A. Area Sources(1)	410	--	--	2,320	--	--	
B. Point Sources	15,375	3,504	42,052	8,632	260	--	
III. SOLID WASTE DISPOSAL							
A. Open Burning							
1.a. Dumps-Area Source	806	50	4,284	1,512	302	100,795	Tons
b. Dumps-Point Source	172	18	514	172	42	17,170	Tons
B. Other							
1. Slash burning-Area Source	54,669	--	160,794	12,864	6,432	6,431,375	Tons
2. Teepees-Point Source	6,027	342	55,526	5,232	3,283	1,626,503	Tons
C. TOTAL SOLID WASTE DISPOSAL	61,674	410	221,118	19,780	10,059	8,175,843	Tons
IV. TRANSPORTATION-AREA SOURCE							
A. Motor Vehicles							
1. Gasoline	384	233	115,012	16,237	12,045	93,143	M gal
2. Diesel	199	357	2,581	516	2,700	15,885	M gal
B. Off-highway Fuel Usage						--	
C. Aircraft	33	71	419	41	27	--	
D. Railroad	192	498	536	383	575	15,322	M gal
E. Gasoline Hndlg. Evap. Losses	--	--	--	978	--	93,143	M gal
F. TOTAL TRANSPORTATION	808	1,159	118,548	18,155	15,347	--	
V. MISCELLANEOUS-AREA SOURCE							
A. Agricultural Burning	76	--	455	91	8	9,240	Tons
B. Forest Wildfires	35,509	--	104,438	8,357	4,178	4,177,500	Tons
C. TOTAL MISCELLANEOUS	35,585	--	104,893	8,448	4,186	4,186,740	Tons
VI. GRAND TOTAL							
A. Area Source	92,832	3,725	389,312	43,595	27,464	--	
B. Point Source	20,779	4,097	98,092	14,902	3,852	--	
C. TOTAL	114,418	7,822	487,404	57,687	31,316	--	

---

(1) Includes particulates from grain elevators and asphalt batching plants and hydrocarbons from solvent evaporation.

TABLE 14. COMPARISON OF POLLUTANT EMISSIONS FOR MONTANA AIR QUALITY CONTROL REGIONS

Source Category	Particulates						SO_2						CO					
	140	141	142	143	144	Total	140	141	142	143	144	Total	140	141	142	143	144	Total
I. Fuel Combustion																		
Residential	150	160	185	103	171	769	543	578	671	374	621	2,787	472	506	584	326	541	2,427
Commercial and Industrial	1,292	431	460	206	395	2,784	15,641	4,140	2,033	1,010	2,128	24,952	310	237	355	197	253	1,352
Utilities	1,050	--	--	3,007	--	4,057	9,354	--		4,264		13,618	202	--	--	160	--	362
Total	2,492	591	645	3,316	566	7,610	25,538	4,718	2,704	5,648	2,749	41,357	984	741	939	683	794	4,141
II. Process Losses																		
Area	2,490	8,874	979	8,096	410	20,849	--	--	--	--	--	--	--	--	--	--	--	--
Point	849	235	66,798	325	15,475	83,582	4,246	36,163	329,195	--	3,504	373,108	37,000	4,589	--	--	42,052	83,641
Total	3,339	9,109	67,777	8,421	15,785	104,431	4,246	36,163	329,195	--	3,504	373,108	37,000	4,589	--	--	42,052	83,641
III. Solid Waste Disposal	2,945	1,938	11,774	619	61,674	78,950	29	100	63	42	410	644	9,706	7,600	46,588	3,558	221,118	288,570
IV. Transportation	830	845	875	563	808	3,921	1,082	1,011	1,112	862	1,159	5,226	133,416	131,738	163,669	67,579	118,548	614,950
V. Stubble burning and Wildfires	4,194	2,164	19,786	1,669	35,585	63,398	--	--	--	--	--	--	13,025	9,679	58,864	6,318	104,893	190,777
Total	13,600	14,647	100,857	14,588	114,418	258,410	30,895	41,992	333,074	6,552	7,822	420,335	194,131	152,345	270,060	78,138	487,405	1,182,079

	HC						NO_x					
	140	141	142	143	144	Total	140	141	142	143	144	Total
I. Fuel Combustion												
Residential	127	137	158	88	146	656	263	279	324	181	300	1,347
Commercial and Industrial	967	182	396	524	206	2,275	2,886	1,537	2,299	2,610	1,164	10,496
Utilities	112	--	--	50	--	162	4,163	--	--	2,903	--	7,066
Total	1,206	319	554	662	352	3,093	7,312	1,816	2,623	5,694	1,464	18,909
II. Process Losses												
Area[1]	2,029	2,161	2,507	1,398	2,320	10,415	--	--	--	--	--	--
Point	20,021	3,691	488	210	8,632	33,042	373	36	--	--	260	669
Total	22,050	5,852	2,995	1,608	10,952	43,457	373	36	--	--	260	669
III. Solid Waste Disposal	1,438	1,915	4,794	1,039	19,780	28,966	463	459	1,589	208	10,059	12,778
IV. Transportation	19,687	19,535	23,741	9,600	18,155	90,718	13,825	13,828	15,310	10,227	15,347	68,537
V. Stubble Burning and Wildfires	1,207	929	4,974	890	8,448	16,348	496	255	2,268	188	4,186	7,391
Total	45,588	28,550	36,958	13,799	57,687	182,582	22,467	16,394	21,790	16,307	31,316	108,284

traffic. However, AQCR 144 CO emission is almost doubled by slash burning and wildfires, and this region leads the state in CO. Much the same situation exists for hydrocarbons and NO_x; a fairly uniform level across the regions except in AQCR 144. In this region these are significantly increased by wildfires and slash burning.

Summary of Fuel Use and Emissions for Hot Spot Areas

Calculated emissions for the eight "hot-spot" areas, also compiled from the computer printouts, are presented in the same format in Tables 15 to 22. Assignment of point sources to the hot spot area was fairly straightforward. Assignment of area-source emissions presented more of a problem, since these data were available only on a whole-county basis. However, most of the area-type emissions are population related, so that where the population is, is where the pollutants originate. Since, as indicated in the following tabulation, most of the people in that county resided in the urban hot-spot area, the area-source emissions can quite properly be attributed to the hot-spot:

Urban Population of Hot-Spot Counties

			Population		
AQCR	Hot-Spot	County	County	Urban Area	% Urban
140	Billings-Laurel	Yellowstone	82,367	75,651	86.6
141	Great Falls	Cascade	81,804	70,905	86.7
142	Helena-E. Helena	Lewis & Clark	33,281	24,381	73.2
142	Butte	Silver Bow	41,981	34,005	81.0
142	Anaconda	Deer Lodge	15,652	10,868	69.3
144	Missoula	Missoula	58,263	43,531	74.7
144	Kalispell-Col. Falls	Flathead	39,460	16,527	41.9
144	Libby-Troy	Lincoln	18,063	4,332	24.0

TABLE 15. EMISSIONS INVENTORY SUMMARY

Billings-Laurel Area

Air Quality Control Region Billings (140)

Data Representative of Calendar Year 1970

SOURCE CATEGORY	TONS OF POLLUTANT/YEAR					FUEL, ETC.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. Residential Fuel-Area Source							
1. Bituminous Coal	42	160	262	63	26	10,495	Tons
2. Distillate Oil	26	190	13	8	32	5,284	M gal
3. Natural Gas	28	1	30	12	112	2,976	MM gal
4. TOTAL	96	351	305	83	170	--	
B. Comm. - Instl. & Ind.							
1.a. (Bituminous) Coal-Area Source	76	87	116	29	20	5,736	Tons
b. (Bituminous) Coal-Point Source	--	--	--	--	--	--	
2.a. Distillate Oil-Area Source	35	168	--	7	63	3,676	M gal
b. Distillate Oil-Point Source						--	
3.a. Residual Oil-Area Source	24	497	--	4	140	2,086	M gal
b. Residual Oil-Point Source	455	11,639	4	59	1,187	39,556	M gal
4.a. Natural Gas-Area Source	24	1	17	24	137	2,516	
b. Natural Gas-Point Source	12	3	2	132	302	2,775	MM cu ft
5.a. Process Gas-Point Source	143	1,326	37	665	2,886	11,182	MM cu ft
6. TOTAL	769	13,721	176	920	4,735	--	
C. Steam-Electric Power Plant							
1. Bituminous Coal	1,025	9,188	202	60	3,627	403,000	Tons
2. Distillate Oil						--	
3. Residual Oil	4	165	--	3	55	1,040	M gal
4. Natural Gas	19	1	--	49	481	2,469	MM cu ft
5. TOTAL	1,048	9,354	202	112	4,163	--	
D. TOTAL FUEL COMBUSTION	1,913	23,426	683	1,115	9,068		
II. PROCESS LOSSES							
A. Area Sources (1)	377	--	--	1,311	--	--	
B. Point Sources	737	4,246	37,000	20,021	373	--	
III. SOLID WASTE DISPOSAL							
A. Open Burning							
1.a. Dumps-Area Source	170	11	903	319	64	21,236	
b. Dumps-Point Source	12	--	12	3	1	195	
B. Other							
1. Slash burning-Area Source						--	
2. Teepees-Point Source						--	
C. TOTAL SOLID WASTE DISPOSAL	182	11	915	322	65	--	
IV. TRANSPORTATION-AREA SOURCE							
A. Motor Vehicles							
1. Gasoline	239	145	95,748	12,766	6,782	48,400	M gal
2. Diesel	83	150	1,082	216	132	6,661	M gal
B. Off-highway Fuel Usage	114	89	571	440	103	--	
C. Aircraft	57	149	161	115	172	4,597	M gal
D. Railroad							
E. Gasoline Hndlg. Evap. Losses	--	--	--	609	--	48,400	M gal
F. TOTAL TRANSPORTATION	493	533	97,562	14,146	7,189	--	
V. MISCELLANEOUS-AREA SOURCE							
A. Agricultural Burning	33	--	190	38	4	--	
B. Forest Wildfires						--	
C. TOTAL MISCELLANEOUS	33	--	190	38	4	--	
VI. GRAND TOTAL							
A. Area Source	1,328	1,648	99,093	15,961	7,787		
B. Point Source	2,407	26,568	37,257	20,992	8,912		
C. TOTAL	3,735	28,216	136,350	36,953	16,699		

---

(1) Includes particulates from grain elevators and asphalt batching plants and hydrocarbons from solvent evaporation.

TABLE 16. EMISSIONS INVENTORY SUMMARY

Great Falls Area

Air Quality Control Region Great Falls (141)

Data Representative of Calendar Year 1970

SOURCE CATEGORY	TONS OF POLLUTANT/YEAR					FUEL, ETC.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. Residential Fuel-Area Source							
1. Bituminous Coal	39	149	246	59	25	9,826	Tons
2. Distillate Oil	25	178	12	7	30	4,948	M gal
3. Natural Gas	26	1	28	11	104	2,786	MM gal
4. TOTAL	90	328	286	77	159	--	
B. Comm. - Instl. & Ind.							
1.a. (Bituminous) Coal-Area Source	66	74	96	24	18	4,868	Tons
b. (Bituminous) Coal-Point Source						--	
2.a. Distillate Oil-Area Source	30	142	--	6	119	3,960	M gal
b. Distillate Oil-Point Source						--	
3.a. Residual Oil-Area Source	21	437	--	2	55	1,833	M gal
b. Residual Oil-Point Source							
4.a. Natural Gas-Area Source	20	--	14	22	120	2,168	MM cu ft
b. Natural Gas-Point Source	--	--	--	47	476	2,440	MM cu ft
5.a. Process Gas-Point Source	5	5	--	916	72	594	MM cu ft
6. TOTAL	142	658	110	1,017	860	--	
C. Steam-Electric Power Plant							
1. Bituminous Coal							
2. Distillate Oil							
3. Residual Oil							
4. Natural Gas							
5. TOTAL							
D. TOTAL FUEL COMBUSTION	232	986	396	1,094	1,019		
II. PROCESS LOSSES							
A. Area Sources(1)	755	--	--	1,227	--	--	
B. Point Sources	229	36,153	4,000	904	18	--	
III. SOLID WASTE DISPOSAL							
A. Open Burning							
1.a. Dumps-Area Source	174	11	926	327	65	21,795	Tons
b. Dumps-Point Source	600	60	1,800	600	15	60,006	Tons
B. Other							
1. Slash burning-Area Source	228	--	672	54	27	--	
2. Teepees-Point Source						--	
C. TOTAL SOLID WASTE DISPOSAL	1,002	71	3,398	981	107	--	
IV. TRANSPORTATION-AREA SOURCE							
A. Motor Vehicles							
1. Gasoline	212	128	84,626	11,283	5,994	47,650	M gal
2. Diesel	71	129	928	186	971	5,713	M gal
B. Off-highway Fuel Usage						--	
C. Aircraft							
D. Railroad	54	141	152	109	163	4,341	M gal
E. Gasoline Hndlg. Evap. Losses	--	--	--	539	--	47,650	M gal
F. TOTAL TRANSPORTATION	337	398	85,706	12,117	7,128	--	
V. MISCELLANEOUS-AREA SOURCE							
A. Agricultural Burning	43	--	250	50	5	--	
B. Forest Wildfires	538	--	1,581	127	63	--	
C. TOTAL MISCELLANEOUS	581	--	1,831	177	68	--	
VI. GRAND TOTAL							
A. Area Source	2,302	1,390	89,531	14,033	7,759	--	
B. Point Source	834	36,218	5,800	2,467	581	--	
C. TOTAL	3,136	37,608	95,331	16,500	8,340		

---

(1) Includes particulates from grain elevators and asphalt batching plants and hydrocarbons from solvent evaporation.

TABLE 17. EMISSIONS INVENTORY SUMMARY

Anaconda Area

Air Quality Control Region Helena (142)

Data Representative of Calendar Year 1970

SOURCE CATEGORY	TONS OF POLLUTANT/YEAR Part	SO_2	CO	HC	NO_x	FUEL, ETC. Quantity	Units
I. FUEL COMBUSTION							
A. Residential Fuel-Area Source							
1. Bituminous Coal	8	29	47	11	5	1,880	Tons
2. Distillate Oil	5	34	2	1	6	947	M gal
3. Natural Gas	7	--	5	2	20	533	MM cu ft
4. TOTAL	20	63	54	14	31	--	
B. Comm. - Instl. & Ind.							
1.a. (Bituminous) Coal-Area Source	7	11	18	4	2	715	Tons
b. (Bituminous) Coal-Point Source						--	
2.a. Distillate Oil-Area Source	5	22	--	1	18	601	M gal
b. Distillate Oil-Point Source						--	
3.a. Residual Oil-Area Source	2	38	--	--	5	159	M gal
b. Residual Oil-Point Source						--	
4.a. Natural Gas-Area Source	--	--	3	1	10	260	MM cu ft
b. Natural Gas-Point Source	84	3	4	182	801	9,267	MM cu ft
5.a. Process Gas-Point Source						--	
6. TOTAL	98	74	25	188	836	--	
C. Steam-Electric Power Plant							
1. Bituminous Coal							
2. Distillate Oil							
3. Residual Oil							
4. Natural Gas							
5. TOTAL							
D. TOTAL FUEL COMBUSTION	118	137	69	202	867		
II. PROCESS LOSSES							
A. Area Sources(1)	--	--	--	235	--	--	
B. Point Sources	39,336	239,174	--	--	--	--	
III. SOLID WASTE DISPOSAL							
A. Open Burning							
1.a. Dumps-Area Source	47	3	251	89	18	5,903	Tons
b. Dumps-Point Source	101	10	317	104	26	10,209	Tons
B. Other							
1. Slash burning-Area Source	709	--	2,084	167	83	--	
2. Teepees-Point Source							
C. TOTAL SOLID WASTE DISPOSAL	857	13	2,652	360	127	--	
IV. TRANSPORTATION-AREA SOURCE							
A. Motor Vehicles							
1. Gasoline	35	21	13,907	1,854	985	7,030	M gal
2. Diesel	12	21	154	31	162	950	M gal
B. Off-highway Fuel Usage						--	
C. Aircraft						--	
D. Railroad	3	8	9	6	10	255	M gal
E. Gasoline Hndlg. Evap. Losses	--	--	--	88	--	7,030	M gal
F. TOTAL TRANSPORTATION	50	50	14,070	1,979	1,157	--	
V. MISCELLANEOUS-AREA SOURCE							
A. Agricultural Burning						--	
B. Forest Wildfires	410	--	1,206	97	48	--	
C. TOTAL MISCELLANEOUS							
VI. GRAND TOTAL							
A. Area Source	1,250	187	17,686	2,587	1,372	--	
B. Point Source	39,521	239,187	17,321	286	1,827	--	
C. TOTAL	40,771	239,374	18,007	2,873	2,199	--	

(1) Includes particulates from grain elevators and asphalt batching plants and hydrocarbons from solvent evaporation.

TABLE 18. EMISSIONS INVENTORY SUMMARY

Butte Area

Air Quality Control Region Helena (142)

Data Representative of Calendar Year 1970

SOURCE CATEGORY	TONS OF POLLUTANT/YEAR					FUEL, ETC.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. Residential Fuel-Area Source							
1. Bituminous Coal	20	77	126	30	13	5,042	Tons
2. Distillate Oil	13	91	6	4	15	2,539	M gal
3. Natural Gas	14	0	14	6	54	1,430	MM cu ft
4. TOTAL	47	168	146	40	82	--	
B. Comm. - Instl. & Ind.							
1.a. (Bituminous) Coal-Area Source	32	41	60	14	8	2,685	Tons
b. (Bituminous) Coal-Point Source						--	
2.a. Distillate Oil-Area Source	17	80	--	3	66	2,220	M gal
b. Distillate Oil-Point Source	1,000	--	--	--	--	235	M gal
3.a. Residual Oil-Area Source	9	193	--	1	24	808	M gal
b. Residual Oil-Point Source						--	
4.a. Natural Gas-Area Source	10	--	9	7	52	1,088	MM cu ft
b. Natural Gas-Point Source	14	--	--	31	134	1,536	MM cu ft
5.a. Process Gas-Point Source						--	
6. TOTAL	1,082	314	69	56	284	--	
C. Steam-Electric Power Plant							
1. Bituminous Coal							
2. Distillate Oil							
3. Residual Oil							
4. Natural Gas							
5. TOTAL							
D. TOTAL FUEL COMBUSTION	1,129	482	215	96	366		
II. PROCESS LOSSES							
A. Area Sources(1)	2	--	--	630	--	--	
B. Point Sources	1,438	1	--	--	--	--	
III. SOLID WASTE DISPOSAL							
A. Open Burning							
1.a. Dumps-Area Source	149	9	794	280	56	18,683	
b. Dumps-Point Source						--	
B. Other							
1. Slash burning-Area Source	156	--	459	37	18	--	
2. Teepees-Point Source	8	--	156	13	11	2,400	
C. TOTAL SOLID WASTE DISPOSAL	313	9	1,409	330	85	--	
IV. TRANSPORTATION-AREA SOURCE							
A. Motor Vehicles							
1. Gasoline	103	62	41,019	5,469	2,906	20,700	M gal
2. Diesel	32	57	410	82	428	2,520	M gal
B. Off-highway Fuel Usage	94	169	1,220	244	1,280	7,500	M gal
C. Aircraft	24	6	33	93	26	--	
D. Railroad	19	50	54	38	57	1,532	M gal
E. Gasoline Hndlg. Evap. Losses	--	--	--	261	--	20,700	M gal
F. TOTAL TRANSPORTATION	272	344	42,727	6,187	4,697		
V. MISCELLANEOUS-AREA SOURCE							
A. Agricultural Burning						--	
B. Forest Wildfires	516	--	1,519	122	61	--	
C. TOTAL MISCELLANEOUS	516	--	1,519	122	61	--	
VI. GRAND TOTAL							
A. Area Source	1,210	835	45,714	7,321	5,064		
B. Point Source	2,460		156	44	145		
C. TOTAL	3,670	836	45,870	7,365	5,209		

---

(1) Includes particulates from grain elevators and asphalt batching plants and hydrocarbons from solvent evaporation.

TABLE 19 EMISSIONS INVENTORY SUMMARY

Helena-East Helena Area

Air Quality Control Region Helena (142)

Data Representative of Calendar Year 1970

SOURCE CATEGORY	TONS OF POLLUTANT/YEAR					FUEL, ETC.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. Residential Fuel-Area Source							
1. Bituminous Coal	16	61	100	24	10	3,997	Tons
2. Distillate Oil	10	77	5	3	12	2,013	M gal
3. Natural Gas	11	--	11	5	43	1,134	MM gal
4. TOTAL	37	133	116	32	65	--	
B. Comm. - Instl. & Ind.							
1.a. (Bituminous) Coal-Area Source	28	35	50	12	7	2,297	Tons
b. (Bituminous) Coal-Point Source	45	680	45	25	340	45,000	Tons
2.a. Distillate Oil-Area Source	15	69	--	3	56	1,893	M gal
b. Distillate Oil-Point Source						--	
3.a. Residual Oil-Area Source	8	172	--	1	21	722	M gal
b. Residual Oil-Point Source						--	
4.a. Natural Gas-Area Source	9	--	7	7	42	947	MM gal
b. Natural Gas-Point Source	1	--	--	1	6	67	MM gal
5.a. Process Gas-Point Source						--	
6. TOTAL	106	956	102	49	472	--	
C. Steam-Electric Power Plant							
1. Bituminous Coal							
2. Distillate Oil							
3. Residual Oil							
4. Natural Gas							
5. TOTAL							
D. TOTAL FUEL COMBUSTION	143	1,089	228	81	537		
II. PROCESS LOSSES							
A. Area Sources(1)	14	--	-	499	--	--	
B. Point Sources	2,646	90,020	--	488	--	--	
III. SOLID WASTE DISPOSAL							
A. Open Burning							
1.a. Dumps-Area Source	85	5	450	159	32	10,591	Tons
b. Dumps-Point Source						--	
B. Other							
1. Slash burning-Area Source	1,630	--	4,794	384	192	--	
2. Teepees-Point Source	42	1	780	66	6	12,000	Tons
C. TOTAL SOLID WASTE DISPOSAL	1,757	6	6,024	609	230	--	
IV. TRANSPORTATION-AREA SOURCE							
A. Motor Vehicles							
1. Gasoline	90	54	35,864	4,782	2,540	18,050	M gal
2. Diesel	33	60	431	86	451	2,652	M gal
B. Off-highway Fuel Usage						--	
C. Aircraft	63	39	236	162	119	--	
D. Railroad	26	66	72	51	77	2,043	M gal
E. Gasoline Hndlg. Evap. Losses	--	--	--	228	--	18,050	M gal
F. TOTAL TRANSPORTATION	212	219	36,603	5,309	3,187	--	
V. MISCELLANEOUS-AREA SOURCE							
A. Agricultural Burning	24	--	140	28	3	--	
B. Forest Wildfires	2,720	--	8,000	640	320	--	
C. TOTAL MISCELLANEOUS	2,744		8,140	668	323	--	
VI. GRAND TOTAL							
A. Area Source	4,782	633	50,160	7,074	3,925		
B. Point Source	2,734	90,701	825	580	352		
C. TOTAL	7,516	91,334	51,985	7,654	4,277		

(1) Includes particulates from grain elevators and asphalt batching plants and hydrocarbons from solvent evaporation.

TABLE 21 EMISSIONS INVENTORY SUMMARY
Missoula Area
Air Quality Control Region Missoula (144)
Data Representative of Calendar Year 1970

SOURCE CATEGORY	TONS OF POLLUTANT/YEAR					FUEL, ETC.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. Residential Fuel-Area Source							
1. Bituminous Coal	28	106	175	42	17	6,998	Tons
2. Distillate Oil	18	127	9	5	21	3,524	M gal
3. Natural Gas	19	1	20	8	74	1,985	MM cu ft
4. TOTAL	65	234	204	55	112	--	
B. Comm. - Instl. & Ind.							
1.a. (Bituminous) Coal-Area Source	67	66	71	18	18	4,282	Tons
b. (Bituminous) Coal-Point Source							
2.a. Distillate Oil-Area Source	26	123	--	6	103	3,408	M gal
b. Distillate Oil-Point Source							
3.a. Residual Oil-Area Source	23	478	--	3	60	2,003	M gal
b. Residual Oil-Point Source							
4.a. Natural Gas-Area Source	20	--	10	26	134	2,114	MM cu ft
b. Natural Gas-Point Source							
5.a. Process Gas-Point Source							
6. TOTAL	136	667	81	53	315	--	
C. Steam-Electric Power Plant							
1. Bituminous Coal							
2. Distillate Oil							
3. Residual Oil							
4. Natural Gas							
5. TOTAL							
D. TOTAL FUEL COMBUSTION	201	901	285	108	427		
II. PROCESS LOSSES							
A. Area Sources(1)	19	--	--	874	--	--	
B. Point Sources	5,511	3,504	42,052	8,632	260	--	
III. SOLID WASTE DISPOSAL							
A. Open Burning							
1.a. Dumps-Area Source	231	14	1,227	433	87	28,874	Tons
b. Dumps-Point Source						--	
B. Other							
1. Slash burning-Area Source	3,709	--	13,850	1,108	554	--	
2. Teepees-Point Source	1,245	77	9,651	933	627	431,233	Tons
C. TOTAL SOLID WASTE DISPOSAL	6,185	91	24,728	2,474	1,268	--	
IV. TRANSPORTATION-AREA SOURCE							
A. Motor Vehicles							
1. Gasoline	152	92	60,878	8,117	4,312	30,700	M gal
2. Diesel	55	99	714	143	747	1,392	M gal
B. Off-highway Fuel Usage						--	
C. Aircraft							
D. Railroad	50	131	141	101	151	4,035	M gal
E. Gasoline Hndlg. Evap. Losses	--	--	--	387	--	30,700	M gal
F. TOTAL TRANSPORTATION	257	322	61,733	8,748	5,210	--	
V. MISCELLANEOUS-AREA SOURCE							
A. Agricultural Burning	18	--	105	21	2	--	
B. Forest Wildfires	3,627	--	10,669	854	427	--	
C. TOTAL MISCELLANEOUS	3,645	--	10,774	875	429	--	
VI. GRAND TOTAL							
A. Area Source	9,062	1,237	87,869	12,146	6,707	--	
B. Point Source	6,756	3,581	51,703	9,565	887	--	
C. TOTAL	15,818	4,818	139,572	21,711	7,594	--	

(1) Includes particulates from grain elevators and asphalt batching plants and hydrocarbons from solvent evaporation.

TABLE 21. EMISSIONS INVENTORY SUMMARY

Kalispell-Whitefish-Columbia Falls Area

Air Quality Control Region Missoula (144)

Data Representative of Calendar Year 1970

SOURCE CATEGORY	TONS OF POLLUTANT/YEAR					FUEL, ETC.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. Residential Fuel-Area Source							
1. Bituminous Coal	19	72	118	28	12	4,740	Tons
2. Distillate Oil	12	86	6	4	14	2,387	M gal
3. Natural Gas	13	--	13	5	50	1,344	MM cu ft
4. TOTAL	44	158	137	37	76	--	
B. Comm. - Instl. & Ind.							
1.a. (Bituminous) Coal-Area Source	52	53	60	15	14	3,444	Tons
b. (Bituminous) Coal-Point Source						--	
2.a. Distillate Oil-Area Source	21	99	--	4	82	1,546	M gal
b. Distillate Oil-Point Source						--	
3.a. Residual Oil-Area Source	18	369	--	3	47	2,753	M gal
b. Residual Oil-Point Source						--	
4.a. Natural Gas-Area Source	15	--	9	19	103	1,666	MM cu ft
b. Natural Gas-Point Source						--	
5.a. Process Gas-Point Source						--	
6. TOTAL	106	521	69	41	246	--	
C. Steam-Electric Power Plant							
1. Bituminous Coal							
2. Distillate Oil							
3. Residual Oil							
4. Natural Gas							
5. TOTAL							
D. TOTAL FUEL COMBUSTION	150	679	206	78	322		
II. PROCESS LOSSES							
A. Area Sources(1)	185	--	--	592	--	--	
B. Point Sources	8,751	--	--	--	--	--	
III. SOLID WASTE DISPOSAL							
A. Open Burning							
1.a. Dumps-Area Source	184	12	978	345	69	23,019	Tons
b. Dumps-Point Source	139	13	415	139	34	13,885	Tons
B. Other							
1. Slash burning-Area Source	27,292	--	80,272	6,422	3,211	--	
2. Teepees-Point Source	1,077	16	19,628	1,663	163	321,500	Tons
C. TOTAL SOLID WASTE DISPOSAL	28,692	41	101,293	8,569	3,477	--	
IV. TRANSPORTATION-AREA SOURCE							
A. Motor Vehicles							
1. Gasoline	98	60	22,973	3,446	3,282	20,000	M gal
2. Diesel	55	98	709	142	742	4,364	M gal
B. Off-highway Fuel Usage						--	
C. Aircraft						--	
D. Railroad	38	100	107	77	115	3,064	M gal
E. Gasoline Hndlg. Evap. Losses	--	--	251	--	--	20,000	M gal
F. TOTAL TRANSPORTATION	191	258	24,040	3,665	4,139	--	
V. MISCELLANEOUS-AREA SOURCE							
A. Agricultural Burning	20	--	120	24	2	--	
B. Forest Wildfires	9,231	--	27,150	2,172	1,086	--	
C. TOTAL MISCELLANEOUS	9,251	--	27,270	2,196	1,088	--	
VI. GRAND TOTAL							
A. Area Source	37,253	949	132,766	13,298	8,829		
B. Point Source	9,967	29	20,043	1,802	197		
C. TOTAL	47,220	978	152,809	15,100	9,026		

(1) Includes particulates from grain elevators and asphalt batching plants and hydrocarbons from solvent evaporation.

TABLE 22. EMISSIONS INVENTORY SUMMARY

Libby-Troy Area

Air Quality Control Region Missoula (144)

Data Representative of Calendar Year 1970

SOURCE CATEGORY	TONS OF POLLUTANT/YEAR					FUEL, ETC,	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. Residential Fuel-Area Source							
1. Bituminou Coal	9	33	54	13	5	2,170	Tons
2. Distillate Oil	5	39	3	2	7	1,093	M gal
3. Natural Gas	6	--	6	2	23	615	MM cu ft
4. TOTAL	20	72	63	17	35	--	
B. Comm. - Instl. & Ind.							
1.a. (Bituminous) Coal-Area Source	28	25	25	6	7	1,662	Tons
b. (Bituminous) Coal-Point Source						--	
2.a. Distillate Oil-Area Source	10	47	--	2	39	1,305	M gal
b. Distillate Oil-Point Source						--	
3.a. Residual Oil-Area Source	10	210	--	1	26	879	M gal
b. Residual Oil-Point Source	12	232	--	2	32	1,080	M gal
4.a. Natural Gas-Area Source	8	--	3	12	60	875	MM cu ft
b. Natural Gas-Point Source						--	
5.a. Process Gas-Point Source						--	
6. TOTAL	68	514	28	23	164	--	
C. Steam-Electric Power Plant							
1. Bituminous Coal							
2. Distillate Oil							
3. Residual Oil							
4. Natural Gas							
5. TOTAL							
D. TOTAL FUEL COMBUSTION	88	586	91	40	199		
II. PROCESS LOSSES							
A. Area Sources(1)	--	--	--	271	--	--	
B. Point Sources	316	--	--	2	32	--	
III. SOLID WASTE DISPOSAL							
A. Open Burning							
1.a. Dumps-Area Source	119	7	630	222	44	14,832	Tons
b. Dumps-Point Source	33	3	99	33	8	3,285	Tons
B. Other							
1. Slash burning-Area Source	9,442	--	27,772	2,222	1,111	--	
2. Teepees-Point Source	475	--	449	374	1,743	--	
C. TOTAL SOLID WASTE DISPOSAL	10,069	10	28,950	2,851	2,906	-	
IV. TRANSPORTATION-AREA SOURCE							
A. Motor Vehicles							
1. Gasoline	41	25	9,457	1,419	1,351	8,180	M gal
2. Diesel	26	46	335	67	350	2,060	M gal
B. Off-highway Fuel Usage						--	
C. Aircraft						--	
D. Railroad	31	80	86	61	92	2,452	M gal
E. Gasoline Hndlg. Evap. Losses							
F. TOTAL TRANSPORTATION	98	151	9,878	1,650	1,793	--	
V. MISCELLANEOUS-AREA SOURCE							
A. Agricultural Burning							
B. Forest Wildfires	8,757	--	25,756	2,061	1,030	--	
C. TOTAL MISCELLANEOUS	8,757	--	25,756	2,061	1,030	--	
VI. GRAND TOTAL							
A. Area Source	18,492	512	64,127	6,464	4,145	--	
B. Point Source	836	235	548	411	1,815	--	
C. TOTAL	19,328	747	64,675	6,875	5,960	--	

(1) Includes particulates from grain elevators and asphalt batching plants and hydrocarbons from solvent evaporation.

Libby-Troy and Kalispell-Whitefish-Columbia Falls do not meet the criterion of urban population, but the emission problems in these two areas result from four principal sources: slash burning, wildfires, teepee burners, and automobiles, whose effects tend to be county-wide.

Summary of Aircraft Traffic and Emissions

Detailed data were desired for aircraft traffic and emissions. Aircraft traffic data are shown in Table 23; emissions are presented in Table 24. These data suggest that aircraft are but a minor pollution source in Montana.

Summary of Vehicular Traffic

Much more important in Montana, as elsewhere, are automobiles and trucks. Emission data for each region were presented in the Summary Emission Tables. Gasoline consumption and urban (25 m.p.h.) and rural (45 m.p.h.) mileage are contained in the following tabulation:

	Automotive Traffic			Diesel Traffic	
		Auto Mileage, Thous. miles (1)			
	Gasoline, M gal	Urban, (25 mph)	Rural, (45 mph)	Diesel Fuel, M gal	Mileage(2) Thous. miles
140 Billings	88,015	823,540	276,650	11,190	57,060
141 Great Falls	86,858	810,640	275,090	12,293	62,090
142 Helena	101,702	1,138,175	133,110	11,370	57,999
143 Miles City	55,000	213,990	473,500	11,694	59,640
144 Missoula	93,140	461,200	703,040	12,264	62,550

(1) Based on average of 12.5 mi/gal.
(2) Based on average of 5.1 mi/gal.

TABLE 23. ANNUAL AIRCRAFT TRAFFIC BY TYPES AT SELECTED AIRFIELDS IN MONTANA(a)(b)

	Commercial Aircarriers			General Aviation	Military	Total LTO Cycles(c)
	Turbojet	Turboprop	Total			
Billings	6219	5268	11,487	42,000	1500	55,556
Great Falls	5494	5268	10,762	35,500	6500	52,762
Butte	1693	1395	3088	N. D.	N. D.	3098
Helena	1190	1246	2436	14,500	4500	21,436
Missoula	1174	1404	2578	44,500	500	47,578
Kalispell	--	731	731	41,000	N. D.	41,731
Bozeman	698	709	1407	30,000	200	31,607
Malmstrom AFB	--	--	--	--	15,000	15,000

(a) Commercial air carrier data - "Airport Activity" Statistics of Certificated Route Air Carriers" - FAA (1969).(28)

(b) General aviation and military traffic estimated by Denver, Colorado FAA Office.

(c) LTO cycle = one landing plus one takeoff.

TABLE 24. ANNUAL EMISSIONS FROM MONTANA AIRCRAFT TRAFFIC[(a)]

	Particulates	SO_2	CO	HC	NO_2
Billings					
Comml-Turbojet	61.6	17.2	152.4	378.	57.2
-Turboprop	39.9	6.6	13.3	19.9	33.2
Genl Aviation	0.6	63.0	378.0	12.6	6.3
Mltry Aviation	12.0	2.0	27.5	29.2	6.0
TOTAL	113.9	88.8	571.2	439.7	102.7
Great Falls					
Comml-Turbojet	52.7	14.4	132.1	234.3	47.9
-Turboprop	40.0	6.7	13.3	20.0	33.2
Genl Aviation	5.4	54.2	325.0	10.8	5.4
Mltry Aviation	53.6	9.8	117.0	126.5	24.4
TOTAL	151.7	85.1	587.4	391.6	110.9
Butte					
Comml-Turbojet	11.8	3.4	27.1	84.7	11.8
-Turboprop	11.7	2.7	5.5	8.3	14.0
Genl Aviation	N. D.	N. D.	N. D.	N. D.	N. D.
Mltry Aviation	N. D.	N. D.	N. D.	N. D.	N. D.
TOTAL	23.5	6.1	32.6	93.0	25.8
Helena					
Comml-Turbojet	8.8	5.0	20.4	62.3	87.2
-Turboprop	15.0	5.0	5.0	7.5	12.5
Genl Aviation	2.1	21.8	130.0	4.3	2.1
Mltry Aviation	37.0	6.8	81.0	87.5	16.9
TOTAL	62.9	38.6	236.4	161.6	118.7
Missoula					
Comml-Turbojet	1.0	.3	2.5	7.2	1.0
-Turboprop	21.2	3.5	7.1	10.6	17.2
Genl Aviation	6.7	66.8	400.0	13.3	6.7
Mltry Aviation	3.7	0.7	9.0	9.7	2.0
TOTAL	32.6	71.3	418.6	40.8	26.9

REFERENCES

1. Northwestern Tour Book - American Automobile Association, Washington, D. C. (1970).

2. Anon., "Status of Air Pollution Control in Montana", Division of Air Pollution Control, Industrial Hygiene, and Radiation, Montana State Department of Health, Helena, Montana, December 31, 1970.

3. Bierbaum, P. J., and Gedgaudas, M. J., "Air Pollutant Emissions Inventory Techniques" (Rough Draft) U. S. Environmental Protection Agency, August, 1969.

4. McGraw, M. J., and Duprey, R. L., "Air Pollutant Emission Factors" Preliminary Document. U. S. Environmental Protection Agency, Research Triangle Park, Preliminary Draft, April, 1971.

5. Environmental Protection Agency [42 CFR Part 420]. National Ambient Air Quality Standards. Notice of Proposed Regulations for Preparation, Adoption and Submittal of Implementation Plans. Federal Register, Volume 36, Number 67. Part II April 7, 1971.

6. Environmental Protection Agency. [42 CFR Part 420]. Requirements for Preparation, Adoption and Submittal of Implementation Plans. Federal Register, Volume 36 Number 158. Part II, August 14, 1971.

7. Anon., "Montana Directory of Manufacturers and Buyers' Guide, 1969-1970". Department of Planning and Economic Development, State of Montana, Helena, Montana.

8. Boubel, R. W., Particulate Emissions from Sawmill Waste Burners. Bulletin No. 42. Engineering Experiment Station, Oregon State University, Corvallis, Oregon. August, 1968.

9. Corder, S. E., Atherton, G. H., Hyde, P. E., and Bonlie, R. W., Wood and Bark Disposal in Wigwam Burners Bulletin No. 11. Forest Research Laboratory, Oregon State University, Corvallis, Oregon, March, 1970.

10. Corder, S. E., Oregon Mill Residues in 1953. Information Circular 7, Oregon Forest Products Laboratory, Corvallis, Oregon, May, 1956.

11. Corder, S. E., personal communication.

12. United States Census of Population-1970. PC(VI)-28. Montana-Advance Report. U. S. Department of Commerce, Bureau of the Census, Washington, D. C. September, 1970.

13. United States Census of Housing-1960. Montana State and Small Areas. U. S. Department of Commerce, Bureau of the Census, Washington, D. C., December, 1961.

14. Climatological Data, National Summary, Annual U. S. Department of Commerce, Environmental Science Services Administration, Washington, D. C.

15. Bituminous Coal and Lignite Distribution-Calendar Year, 1970. Mineral Industry Surveys, U. S. Department of Commerce, Bureau of Mines, Washington, D. C.

16. 1963 Census of Manufacturers-Montana. U. S. Department of Commerce, Bureau of the Census, Washington, D. C. (1966).

17. 1967 Census of Manufacturers-Montana. U. S. Department of Commerce, Bureau of the Census, Washington, D. C., October, 1970.

18. 1967 Census of Business-Retail Trade, Montana, U. S. Department of Commerce, Bureau of the Census, Washington, D. C. May, 1969.

19. 1968 Keystone Coal Buyers' Manual. McGraw-Hill, Inc., New York, New York, 1968.

20. Sales of Fuel Oil and Kerosene in 1969. Mineral Industry Surveys, U. S. Department of the Interior, Bureau of Mines, Washington, D. C. September 30, 1970.

21. McCormick, E., American Gas Association, Washington, D. C., personal communication.

22. Brinck, C. W., and Carmody, T. D., Montana Solid Waste Status Report and Management Plan Montana State Department of Health, Helena, Montana, 1970.

23. Carmody, T. D., Montana State Department of Health, Helena, Montana, personal communication.

24. Montana Directory of Licensed Grain Dealers, Public Warehousemen, etc. License Year 1970-1971. Montana Department of Agriculture, Division of Grain Standards and Marketing, Helena, Montana.

25. Fastrup, E., Marketing Research Specialist, Montana Department of Agriculture, Helena, Montana, personal communication.

26. Montana Wheat Estimates by Counties-Preliminary, 1970. U. S. Department of Agriculture-Statistical Reporting Service, Helena, Montana, March 23, 1971.

27. Montana Agricultural Statistics-Vol. XIII. County Statistics, 1968 and 1969. Montana State Department of Agriculture and U.S.D.A. Statistical Reporting Service, Helena, Montana, December, 1970.

28. Airport Activity Statistics of Certificated Route Air Carriers-1969. U. S. Department of Transportation, Federal Aviation Administration, Civil Aeronautics Board.

29. Chubbuck, Major, U. S. Air Force, March AFB, California, personal communication.

30. Montana Data Book, Montana Department of Planning and Economic Development, Helena, Montana, 1970.

31. Moore, W. R., Chief of the Division of Fire Control, Region 1, U. S. Forest Service, Missoula, Montana, personal communication.

32. Griffes, R. B., Chief of Division of Forest Management State of Montana, Missoula, Montana, personal communication.

33. Munson, Lt. Col. W. H., Deputy District Engineer, U. S. Army Corps of Engineers, Seattle, Washington, personal communication.

34. Kipp, P., Forester, U. S. Bureau of Indian Affairs, Billings, Montana, personal communication.

35. Olson, M., Asst. Regional Director, Region 6, U. S. Bureau of Reclamation, Billings, Montana, personal communication.

36. Lynd, A., U. S. Bureau of Land Management, Billings, Montana, personal communication.

37. Forest Service Manual: Title 5100 - Fire Control, Slash Smoke Permit System, Region 6, Supplement No. 44. U. S. Forest Service, Portland, Oregon, September, 1969.

38. Boubel, R. W., Darley, E. F., and Schuck, E. A., Emissions from Burning Grass Stubble and Straw. J. Air Pollution Control Association 19, 7, 497-500 (1969).

39. Boubel, R. W., Oregon State University, Corvallis, Oregon, personal communication.

40. Aldrich, H. E., Regional Director, U. S. Department of the Interior, Bureau of Reclamation, Region 6., Billings, Montana, personal communication.

41. Montana Water Resources Board, Helena, Montana, personal communication to D. Holtz, Division of Air Pollution Control, Montana State Board of Health, Helena, Montana.

APPENDIX A

PERTINENT MONTANA AIR POLLUTION REGULATIONS

Regulation 90-004

RESTRICTION OF EMISSION OF PARTICULATE MATTER FROM INDUSTRIAL PROCESSES

A. Emission Limitations

No person shall cause, suffer, allow, or permit to be discharged into the outdoor atmosphere from any operation, process or activity, except (a) fuel burning equipment and (b) incinerators, particulate matter in excess of the amount shown in Table I of this regulation. When the process weight falls between two values in the table, the maximum weight discharged per hour shall be determined by interpolation.

When the process weight exceeds 60,000 pounds per hour, the maximum allowable weight discharged per hour will be determined by use of the following equation:

$$E = 55.0\ P^{0.11} - 40$$

When E = Maximum rate of emission in pounds per hour --
P = Process weight rate in tons per hour.

TABLE I

Process Weight Rate		Rate of Emission	Process Weight Rate		Rate of Emission
Lb/Hr	Tons/Hr	Lb/Hr	Lb/Hr	Tons/Hr	Lb/Hr
100	0.05	0.551	16,000	8.00	16.5
200	0.10	0.877	18,000	9.00	17.9
400	0.20	1.40	20,000	10.	19.2
600	0.30	1.83	30,000	15.	25.2
800	0.40	2.22	40,000	20.	30.5
1,000	0.50	2.58	50,000	25.	35.4
1,500	0.75	3.38	60,000	30.	40.0
2,000	1.00	4.10	70,000	35.	41.3
2,500	1.25	4.76	80,000	40.	42.5
3,000	1.50	5.38	90,000	45.	43.6
3,500	1.75	5.96	100,000	50.	44.6
4,000	2.00	6.52	120,000	60.	46.3
5,000	2.50	7.58	140,000	70.	47.8
6,000	3.00	8.56	160,000	80.	49.0
7,000	3.50	9.49	200,000	100.	51.2
8,000	4.00	10.4	1,000,000	500.	69.0
9,000	4.50	11.2	2,000,000	1,000.	77.6
10,000	5.00	12.0	6,000,000	3,000.	92.7
12,000	6.00	13.6			

Interpolation of the data in this table for process weight rates up to 60,000 lb/hr shall be accomplished by use of the equation $E = 4.10\ P^{0.67}$, and interpolation and extrapolation of the data for process weight rates in excess of 60,000 lb/hr shall be accomplished by use of the equation: $E = 55.0\ P^{0.11} - 40$, where E = rate of emission in lb/hr and P = process weight rate in tons/hr.

B. Effective Date

The effective date of this regulation for existing equipment shall be June 1, 1970. For new equipment, the effective date shall be November 23, 1968

Regulation 90-006

MAXIMUM ALLOWABLE EMISSION OF PARTICULATE MATTER FROM FUEL BURNING EQUIPMENT

A. Particulate Matter from Fuel Burning Equipment

No person shall cause, suffer, allow or permit particulate matter caused by the combustion of fuel to be discharged from any stack or chimney into the atmosphere, in excess of the hourly rate set forth in the following table:

Heat Input in Million British Termal Units per hour	Maximum Allowable Emissions of Particulate Matter in Pounds per Million British Thermal Units	
	Existing Fuel Burning Equipment	New Fuel Burning Equipment
Up to and including 10	0.60	0.60
100	0.40	0.35
1,000	0.28	0.20
10,000 and above	0.19	0.12

B. For a heat input between any two consecutive heat inputs stated in the preceding table, maximum allowable emissions of particulate matter are shown for existing fuel burning equipment on Figure 1 and for new fuel burning equipment on Figure 2. For the purposes hereof, heat input shall be calculated as the aggregate heat content of all fuels (using the upper limit of their range of heating value) whose products of combustion pass through the stack or chimney.

1. When two or more fuel burning units are connected to a single stack, the combined heat input of all units connected to the stack shall be used to determine the allowable emission from the stack.

2. When a single fuel burning unit is connected to two or more stacks, the allowable emission from all the stacks combined shall not exceed that allowable for the same unit connected to a single stack.

C. The effective date of this regulation for existing equipment shall be June 1, 1970. For new equipment, the effective date shall be November 23, 1968.

Regulation 90-008

RESTRICTION OF SULFUR OXIDE EMISSIONS

I. GROUND LEVEL CONCENTRATIONS

A. No person or persons shall cause or permit the emission of sulfur dioxide from any premises which will result in concentrations and frequencies at ground level that exceed the following:

1. Concentrations shall not exceed 2.0 ppm* at any time.

2. Concentrations may exceed 1.0 ppm for not more than 2½ minutes in any 60 consecutive minutes at a frequency of not more than twice in any eight (8) consecutive hours for a total of not more than 15 minutes in any 24 consecutive hours.

3. Concentrations may exceed 0.5 ppm for not more than five (5) minutes in any 60 consecutive minutes at a frequency of not more than twice in any eight (8) consecutive hours for a total of not more than 30 minutes in any 24 consecutive hours.

4. Concentrations may exceed 0.2 ppm for not more than ten (10) minutes in any 60 consecutive minutes at a frequency of not more than twice in any eight (8) consecutive hours for a total of not more than 60 minutes in any 24 consecutive hours.

5. Concentrations may exceed 0.1 ppm for not more than thirty (30) minutes in any 60 consecutive minutes at a frequency of not more than twice in any eight (8) consecutive hours for a total of not more than 150 minutes in any 24 consecutive hours.

6. The average of all concentrations in any 24 consecutive hours shall not exceed 0.1 ppm.

*Parts per million by volume.

B. Emissions exceeding the limits established in this subsection A shall not constitute a violation of this regulation provided such emissions, from the emission point to the point of any such concentration, are on property controlled by the person responsible for such emissions.

C. Ground Level Monitoring

1. Any person or persons responsible for emissions of SO_2 in concentrations of 2000 ppm or more shall, when notified in writing by the director, provide not more than ---

a. Four recording SO_2 monitoring stations in the area surrounding the source, equipped and located in a manner approved by the director, and continuously operated so that the SO_2 concentrations in the atmosphere at ground-level in that locality will be properly measured.

b. The recording SO_2 monitoring stations shall be ordered not more than thirty (30) days after notification by the director and placed in satisfactory operation at sites approved by the director not more than sixty (60) days after receipt from the vendor.

c. The specifications of the recording SO_2 monitoring stations shall be submitted to the director for his approval. Any instrument or equipment not approved shall be deemed in non-compliance with this Section.

2. Such person shall provide at least one recording meteorological station equipped to record wind speed and wind direction.

3. Such person shall provide the necessary care and maintenance services so that the instruments will function properly and adequately record SO_2 exposures, wind speed and direction in the area.

4. Such person shall provide to the director a summary of the data obtained from such instruments during each calendar month. Such summary shall be in such form and detail as will show the degree of compliance with subsection A, and the time, location, extent, and duration of any recorded violation of the provisions of subsection A. Such person shall also include data giving the total mass rate of emission of SO_2 from the emission points specified by the director and a detailed report of instrument performance and maintenance; and shall be submitted within the calendar month immediately succeeding the recording of the data.

5 Such person shall keep for a period of at least one year all records gathered as a result of the requirements of this subsection C and shall make these available to the director at his request.

6. Such person shall examine at the time of each instrument maintenance check and in any case at intervals of no greater than every seven days instrument records taken pursuant to the requirements of subsection C (1) to determine compliance with subsection A. Any recorded violation of subsection A shall be reported to the director within the next normal working day after such examinations

7. Whenever the records indicate that a violation of subsection A has occurred the person or persons responsible for such emission shall furnish evidence that proper action has been taken to prevent recurrence. When instrument records are not adequate to show compliance with subsection A the director may specify the schedule to be followed for producing a satisfactory record history

D. Definitions:

1. "SO_2" shall mean sulfur dioxide.

2. "ppm" shall mean parts of a contaminant per million parts of a gas by volume.

E. The effective date of this Section I of this regulation 90-008 shall be April 30, 1970.

II. REGULATION OF SULFUR IN FUEL

A. Commencing July 1, 1970 no person shall burn liquid or solid fuels containing sulfur in excess of two (2) pounds of sulfur per million Btu fired.

B. Commencing July 1, 1971 no person shall burn liquid or solid fuels containing sulfur in excess of 1.5 pounds of sulfur per million Btu fired.

C. Commencing July 1, 1972 no person shall burn liquid or solid fuels containing sulfur in excess of one (1) pound of sulfur per million Btu fired.

D. Commencing July 1, 1971 no person shall burn any gaseous fuel containing sulfur compounds in excess of 50 grains per 100 cubic feet of gaseous fuel, calculated as hydrogen sulfide at standard conditions. The provisions of this subsection II (D) shall not apply to:

1. The burning of sulfur, hydrogen sulfide, acid sludge or other sulfur compounds in the manufacturing of sulfur or sulfur compounds.

2. The incinerating of waste gases provided that the gross heating value of such gases is less than 300 Btu's per cubic foot at standard conditions and the fuel used to incinerate such waste gases does not contain sulfur or sulfur compounds in excess of the amount specified in this rule.

3. The use of fuels where the gaseous products of combustion are used as raw materials for other processes.

E. Exceptions

1. A permit may be granted by the director to burn fuels containing sulfur in excess of the sulfur contents indicated in Section II of this regulation provided it can be shown that the facility burning the fuel is fired at a rate of one million Btu per hour or less.

2. For purpose of Section II, of this regulation, a higher sulfur-containing fuel may, upon application to the director, be utilized in subsections A, B or C if such fuel is mixed with one or more lower sulfur-containing fuels which results in a mixture, the equivalent sulfur content of which, is not in excess of the stated values when fired.

3. The requirements of subsection A, B or C of Section II of this regulation shall also be deemed to have been satisfied if upon application to the director, a sulfur dioxide control process is applied to remove the sulfur dioxide from the gases emitted by the burning of fuel of any sulfur content which results in an emission of sulfur in pounds per hour not in excess of the pounds per hour of sulfur that would have been emitted by burning fuel of the sulfur content indicated without such a cleaning device.

F. Definition:

1. "Btu" means British thermal unit which is the heat required to raise the temperature of one pound of water through one fahrenheit degree.

III. Maximum allowable emission of reduced sulfur from primary non-ferrous smelters and slag treatment plants.

A. No person or persons shall cause, suffer, allow or permit to be discharged into the outdoor atmosphere from any copper, zinc or lead smelting operation or any slag treatment plant reduced sulfur in excess of the amount shown in the following table:

Total Feed of Sulfur, lb/hr	Allowable Sulfur Emission, lb/hr		
	Cu	Zn	Pb
1,000	100	100	100
5,000	500	394	348
10,000	1,000	704	593
20,000	2,000	1,270	1,000
40,000	4,000	2,310	1,000
60,000	6,000	3,210	1,000
80,000	8,000	4,120	1,000
100,000	10,000	5,000	1,000
over 100,000	10,000	5,000	1,000

B. For a total sulfur feed input between any two consecutive total sulfur feed inputs stated in the preceding table, maximum allowable emissions are shown on figure I of this Section III. For the purposes hereof, total sulfur input shall be calculated as the aggregate sulfur content of all fuels and other feed materials whose products of combustion and gaseous byproducts pass through the stack or chimney.

1. When two or more furnaces, sinter machines, sinter boxes, roasters, converters or other similar devices for converting copper, zinc or lead ores, concentrates, residues or slag to the metal or the oxide of the metal either wholly or in part are connected to a single stack, the combined sulfur input of all units connected to the stack shall be used to determine the allowable emission from the stack.

2. When a single furnace, sinter machine, sinter box, roaster, converter or other similar device for converting copper, zinc, or lead ores, concentrates, residues or slag to the metal or the oxide of the metal either wholly or in part is connected to two or more stacks, the allowable emission from all the stacks combined shall not exceed that allowable from the same unit connected to a single stack.

The effective date of this Section III for existing operations shall be June 30, 1973. For new operations, the effective date shall be June 30, 1970.

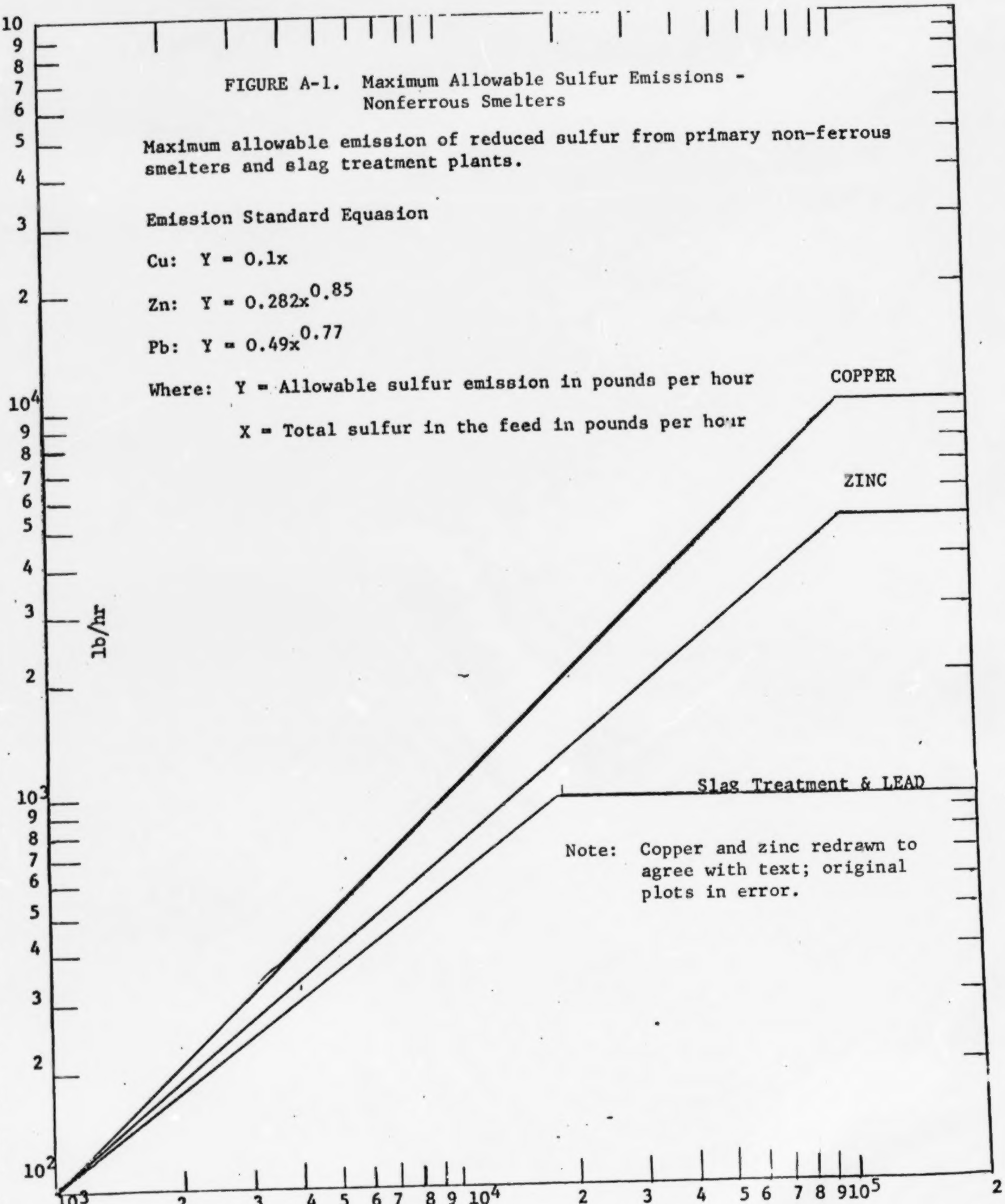


FIGURE A-1. Maximum Allowable Sulfur Emissions - Nonferrous Smelters

Maximum allowable emission of reduced sulfur from primary non-ferrous smelters and slag treatment plants.

Emission Standard Equasion

Cu: $Y = 0.1x$

Zn: $Y = 0.282x^{0.85}$

Pb: $Y = 0.49x^{0.77}$

Where: Y = Allowable sulfur emission in pounds per hour

X = Total sulfur in the feed in pounds per hour

Note: Copper and zinc redrawn to agree with text; original plots in error.

Regulation 90-008

KRAFT PULP MILLS

IV. Maximum allowable emission of total reduced sulfur (TRS) from Kraft pulping mills.

A. No person or persons shall cause, suffer, allow or permit to be discharged into the outdoor atmosphere from any Kraft pulping mill total reduced sulfur in excess of .087 pounds per 1000 pounds of black liquor from each recovery furnace stack or seventeen and one-half (17½) ppm, expressed as hydrogen sulfide on a dry gas basis, whichever is more restrictive or such other limit of TRS that proves to be reasonably attainable utilizing the latest in design of recovery furnace equipment, controls and procedures but not more than 0.087 pounds of TRS per 1000 pounds of black liquor.

B. Non-condensibles from digesters and multiple-effect evaporators shall be treated to reduce the emission of TRS equal to the reduction achieved by thermal oxidation in a lime kiln.

C. Monitoring and Reporting

1. Every kraft mill in the state shall install equipment for the continual monitoring of TRS.

2. The monitoring equipment shall be capable of determining compliance with these standards and shall be capable of continual sampling and recording of the concentrations of TRS contaminants during a time interval not greater than thirty minutes.

3. The sources monitored shall include, but are not limited to, the recovery furnace stacks and the lime kiln stacks.

4. Each mill shall sample the recovery furnace, lime kiln, and smelt tank for particulate emissions on a regularly scheduled basis in accordance with its approved sampling program.

5. Each mill shall submit within sixty days after the effective date of this regulation a detailed monitoring program and time schedule for approval by the director. The equipment shall be ordered within thirty days after the monitoring program has been approved in writing by the director. The equipment shall be placed in effective operation in accordance with approved program within sixty days after delivery.

6. Unless otherwise authorized by the director, data shall be reported by each mill at the end of each calendar month, as follows:

(a) Daily average emission of TRS gases expressed in pounds of sulfur per 1000 pounds of black liquor fired for each source included in the approved monitoring program.

(b) The number of hours each day that the emission of TRS gases from each recovery furnace stack exceeds 17½ ppm dry and the maximum concentration of TRS measured each day.

(c) Emission of TRS gases in pounds of sulfur per 1000 pounds of black liquor fired in the kraft recovery furnace on a monthly basis and pounds of sulfur per hour for the other sources included in the approved monitoring program. Emission of particulates in pounds per hour based upon a sampling conducted in accordance with the approved monitoring program.

(d) Average daily kraft pulp production in air-dried tons and average daily black liquor burning rate.

(e) Other emission data as specified in the approved monitoring program.

7. Each kraft mill shall furnish, upon request of the director, such other pertinent data as may be required to evaluate the mill's emission control program. Each mill shall immediately report abnormal mill operations which result in increased emissions of air contaminants, following procedures set forth in the approved monitoring program.

D. All emission standards in this Section IV shall be based on average daily emissions. The limitations herein shall not preclude a requirement to install the highest and best practicable treatment and control available. New mills or mills expanding existing facilities may be required to meet more restrictive emission limits.

E. Definitions

1. For purposes of this Section IV, the following definitions shall apply:

(a) "Continual monitoring" means sampling and analysis, in a continuous or times sequence, using techniques which will adequately reflect actual emission levels or concentrations on a continuous basis.

(b) "Kraft mill" or "mill" means any pulping process which uses, for cooking liquor, an alkaline sulfide solution containing sodium sulfide.

(c) "Non-condensibles" means gases and vapors from the digestion and evaporation processes of a mill that are not condensed with the equipment used in those processes.

(d) "ppm" (parts per million) means parts of a contaminant per million parts of gas by volume.

(e) "Recovery furnace stack" means the stack from which the products of combustion from the recovery furnace are emitted to the ambient air.

(f) "Total reduced sulfur, (TRS)" means hydrogen sulfide, mercaptans, dimethyl sulfide, dimethyl disulfide, and any other organic sulfides present.

F. The effective date of this Section IV of this regulation 90-008 shall be November 30, 1972 for existing mills and June 30, 1970 for new mills.

Regulation 90-010
Revised January 9, 1970

OPEN BURNING RESTRICTIONS

A. Refuse Burning Restrictions

No person shall cause, suffer, allow or permit an open fire except under the following conditions:

1. When such fire is set or permission for such fire is given in the performance of the official duty of a public officer, and in the opinion of the control officer is necessary:

    a. for the purpose of the elimination of a fire hazard which cannot be abated by any other means.

    b. for instruction in methods of fighting fires.

    c. for the purpose of removing any hazardous material.

2. When such fire is set in the course of an essential agricultural operation in the growing of crops or in the course of accepted forestry practices provided no public nuisance is created and provided a permit has been secured from the control officer.

3. When fires are set for the clearing of lands for new roads under conditions stipulated in writing by the control officer and after having applied for and received a permit for such open fire from the control officer.

4. When salamanders or other devices are used for heating by construction or other workers provided no public nuisance is created and provided no tires, oily rags or other materials producing dense smoke are burned

5. When burning materials originating on the premises by individuals residing on the premises, excluding commercial establishments, where no provision is available by private hauler providing a public service or by a tax supported service for the collection of material being burned and no public nuisance is created, but not including chicken litter, animal droppings, garbage, dead animals, tires, waste oil, tar paper and similar materials creating dense smoke when burned and after having applied for and received a permit from the control officer.

6. When fires are used for outdoor cooking or other recreational purposes and no public nuisance is created.

B. Salvage Operations by Open Fires

No person shall cause, suffer, allow or permit an open fire for the purpose of conducting a salvage operation after July 1, 1969.

1. Until July 1, 1969, fires may be set for preparing salvage material for the scrap market under the following conditions:

a. Authority is granted by the control officer.

b. No automobile tires shall be burned.

c. Burning shall be done between the hours of 12 noon and 5:00 p.m.

d. Burning shall be conducted only if it shall not constitute a public nuisance.

C. Restrictions on Open Burning of Trade Wastes

1. No person shall cause or permit the disposal of trade wastes by open burning, except as provided in subsection C (2) of this regulation.

2. The open burning of trade wastes may be permitted when it can be shown by a person that such open burning is absolutely necessary and in the public interest. Any person intending to engage in open burning of trade wastes shall file a request to do so with the control officer

The application shall state the following:

a. The name, address, and telephone number of the person submitting the application.

b. The type of business or activity involved

c. A description of the proposed equipment and operating practices, the type, quantity, and composition of trade wastes to be burned, and the expected composition and amount of air contaminants to be released to the atmosphere

d. The schedule of burning operations.

e. The exact location where open burning will be used to dispose of trade waste.

f. Reasons why no method other than open burning can be used for disposal of trade waste.

g. Evidence that the proposed open burning has been approved by any fire department or other fire control officer which may have jurisdiction.

D. Effective Date

The effective date of this regulation shall be November 23, 1968.

Regulation 90-014

PREVENTION, ABATEMENT, AND CONTROL OF AIR POLLUTION FROM WOOD-WASTE BURNERS

A. Wood-Waste Burner Construction Prohibited Without Prior Approval

Construction, reconstruction, or substantial alteration of wood-waste burners is prohibited after the effective date of this regulation unless plans and specifications have been submitted to, and approved by, the Director.

B. Emission Standards for Wood-Waste Burners Constructed, Reconstructed, or Substantially Altered after the Effective Date of this Regulation

1. There shall not be discharged into the atmosphere from any wood-waste burner any air contaminant for a period or periods aggregating more than four minutes in any one hour which is

   a. darker in shade than that designated as No. 1 of the Ringelmann Chart, or

   b. of such opacity as to obscure an observer's view to a degree greater than that described in subsection a of this section.

2. Particulate matter shall not be discharged from a wood-waste burner in excess of 0.2 grains per standard cubic foot corrected to 12% CO_2 for existing installations or in excess of 0.1 grains per standard cubic foot corrected to 12% CO_2 for new installations.

C. Existing wood-waste burners shall comply with emission standards of this regulation within 18 months from the effective date of this regulation. All new wood-waste burners shall comply with the emission standards set forth in Section B of this regulation.

D. Existing wood-waste burners shall comply within 18 months from the effective date of this regulation and new wood-waste burners with the following:

1. A thermocouple and recording pyrometer or other approved temperature measurement and recording devices shall be installed and maintained. The thermocouple shall be installed on the burner at a location six inches above and near the center of the horizontal screen or at another approved location.

2. A daily written log of the wood-waste burner operation shall be maintained to determine optimum patterns of operation for various fuel and atmospheric conditions. The log shall include, but not be limited to, the time of day, draft settings, exit gas temperature, type of fuel, and atmospheric conditions. The log or a copy shall be submitted to the Director within ten days upon request

3. Rubber products, asphaltic materials, or materials which cause dense smoke discharge shall not be burned or disposed of in wood-waste burners.

E. Operation and Maintenance

The owners or operators of all wood-waste burners shall submit the names of operating and maintenance personnel and specify their duties regarding burner operations and control and any other duties not associated with burner operation control. It must be shown that there is adequate responsibility delegated for proper burner operation, control, and maintenance. The owner is responsible for having an operator trained and competent in the operation of the wood-waste burner in charge of the wood-waste burner.

F. Wood-Waste Burner Use Restricted

No person shall use a wood-waste burner for the burning of other than production process wood waste transported to the burner by continuous flow conveying methods.

G. New Wood-Waste Burner Definition

1. Any wood-waste burner constructed or installed after the effective date of this regulation;
2. Any wood-waste burner replaced or altered after the effective date of this regulation as to have any effect on the production or control of air contaminants;
3. Any wood-waste burner moved after the effective date of this regulation to another premise involving a change of address:
4. Any wood-waste burner purchased or otherwise acquired and to be operated after the effective date of this regulation by a new owner or when a new lessee desire to operate such burner.

H. Exceptions

For building of fires in wood-waste burners, the darkness or opacity provision and the particulate provisions under Section B of this regulation may be exceeded for not more than 60 minutes in 8 hours.

I. Effective Date

The effective date of this regulation shall be November 23, 1968, except as otherwise herein provided.

APPENDIX B

CALCULATION OF ALLOWABLE PARTICULATE EMISSIONS FROM WOOD WASTE BURNERS

Calculation of Allowable Particulate Emissions from Wood Waste Burners

Basis: 100 lbs dry "Typical Douglas Fir"(9).

Constituent	Analysis, % by wt.	lb-moles
Carbon	52.3	4.35 lb-moles C
Hydrogen	6.3	3.15 lb-moles H_2
Oxygen	40.5	1.26 lb-moles O_2
Nitrogen	0.1	--
Ash	0.8	--
TOTAL	100.0	

$C + O_2 \rightarrow CO_2$ $\qquad$ $H_2 + 1/2\ O_2 \rightarrow H_2O$

Oxygen Requirements

4.35 moles O_2 for C
1.57 moles O_2 for H_2
5.92 Total
1.26 moles O_2 in wood
4.66 net moles O_2 required

$\frac{79}{21}$ = 3.76 moles N_2/mole O_2 in air

4.66 x 3.76 = 17.5 moles N_2 associated with O_2

$$\frac{4.35 \text{ moles } CO_2}{4.66 + 17.5 \text{ moles air}} = 19.5\%\ CO_2 \text{ at } 0\% \text{ xS air}$$

22.15 moles flue gas @ 359 cu ft/lb-mole

= 7950 cu ft flue gas at STP

At 12% CO_2 = $\frac{19.5}{12.0}$ (7950) = 12,950 cu ft STP

= 130,000 cu ft/1,000 lb dry wood

= 104,000 cu ft/ton wood, as received (assuming 60% moisture)

Allowable

(Regn. 90-014) Present: 0.2 grain/std. cu ft (corrected to 12% CO_2)

New: 0.1 grain/std cu ft

Per ton of "as received" waste charged to teepee

$$= \frac{0.2 \times 104{,}000 \text{ cu ft}}{7{,}000 \text{ gr/lb}} = 3.0 \text{ lbs/ton}$$

APPENDIX C

EXPLANATION OF MONTANA EMISSION INVENTORY COMPUTER PRINTOUTS

Point-Source Emission Inventory

The emission inventory tabulations in general follow the format of the "Point-Source Data Form" (Figure C-1) used for compiling the input data. Computer output is presented in seven different tabulations, as follows:

First Table

Contains input data on point sources, including:

- Source identifying number
- Standard Industrial classification - selected from a limited list of those numbers which the computer program would accept; and therefore, not always the most appropriate one for the industry
- Site number - Repeats source number
- Process code - number categorizing nature of process - from EPA listing
- X and Y Coordinates - UTM coordinates for the source location (from U.S.G.S. maps)
- Political Jurisdiction - County number (from an alphabetical listing of the counties in the AQCR; see Table 1 in text).

Second Table

In general, this table is self-explanatory. Some comments are:

- Plume Rise - Erroneous units - should be "feet"
- Process Weight Rate - Input to process, lbs/hr
- Comment Column - A cryptic note describing the operations
- Use Factor and Shifts/Day - Disregard; an EPA calculation not involved in the emission inventory

APCO (DUR) 193
3/71
REV 3

POINT SOURCE DATA FORM

SOURCE NUMBER	REGION	SIC	SITE	PROCESS CODE	DESCRIPTIVE NAME (a)	COORDINATES KM		POLITICAL JURISDICTION	OWNER (b)	TYPE (c)	OPERATING (hours/year)	STACK PARAMETERS				MAXIMUM GAS VOLUME 10^2 (ACFM)	PLUME RISE (ft^2/sec)	
						X	Y					HEIGHT (ft.)	DIA. (ft.)	TEMP (°F)	VELOCITY (ft/sec)			A

SOURCE NUMBER	MAXIMUM PROCESS WEIGHT RATE (lb/hr)	NORMAL PROCESS WEIGHT RATE (lb/hr)	COMMENTS (a)	MAXIMUM BOILER CAPACITY (10^6 BTU/hr)	(d) EF	COAL (tons/year)	(d) EF	RESIDUAL OIL (10^3 Gal/year)	(d) EF	DISTILLATE OIL (10^3 Gal/year)	(d) EF	NATURAL GAS (10^6 CF/year)	HEAT CONTENT				
													COAL 10^6 (BTU/ton)	RESIDUAL OIL (10^3 BTU/Gal.)	DIST. OIL (10^3 BTU/Gal.)	NATURAL GAS (BTU/CF)	B

SOURCE NUMBER	% ASH COAL	SULFUR CONTENT				CONTROL EFFICIENCY		DEVICE INDENT	COMMENTS (a)	HAND CALCULATED EMISSIONS (tons/year)					ALLOWABLE EMISSIONS (tons/year)		
		COAL	RESID.	DIST.	NAT. GAS	PART	SO_2			PART.	SO_2	CO	HC	NO_2	PART	SO_2	C

SOURCE NUMBER	COMMENTS (a)	
		D

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

(a) Letters and numbers may be put in these columns
(b) Owner → Private 1; Local 2; State 3; Federal 4; Utilities 5.
(c) Type → Process = 1; Fuel Combustion = 2; Solid Waste Disposal = 3.
(d) EF → refers to emission factor set number associated with emission factors on emission factor sheet.
All decimal points are implied and are signified by a ▼ between columns.

FIGURE C-1. POINT SOURCE DATA FORM

- Emission Factor (Set Number) - Series of numbers from 1-20 selecting appropriate computer program parameters for the type of fuel and combustion equipment.

Third Table

A summation of fuel used in the AQCR

Fourth Table

SO_2 and Particulate Emissions

- Computer Calculation - Fuel combustion where emission set factor was supplied
- Hand Calculation - All other emissions had to be hand-calculated
- Allowable - Allowable emission based on state regulations (Federal allowables are shown in the 7th table)

Fifth Table

Similar tabulation of CO, HC, and NO_2 emissions

Sixth Table

Tabulation of emission data by county for the various use categories.

Seventh Table

Allowable emissions for particulates and SO_2 based on guidelines in April 7, 1971 Federal Register.

- Number of UTM zone
- Comments and address of source

Area Source Emission Inventory

Like the point-source emission inventory, the area-source inventory tabulation in general follows the format of the "Area 2 Source Data" form (Figure C-2) used for compiling the input data.

Tables 1-3 are tabulated according to political jurisdiction (county). Totals of each column are the total of that pollutant for the AQCR.

Table 1 - Pollutant Particulate

- Fields A-1 to A-7 (Area Data Form)

Table 2 - Pollutant Particulate

- Fields A-8 to A-22 (A-19, "Other", used for gasoline marketing)

Table 3 - Pollutant Particulate

Hand-calculated emissions calculated for the additional non-standard source types (Fields P-1 to P-6 of Area Data Form).

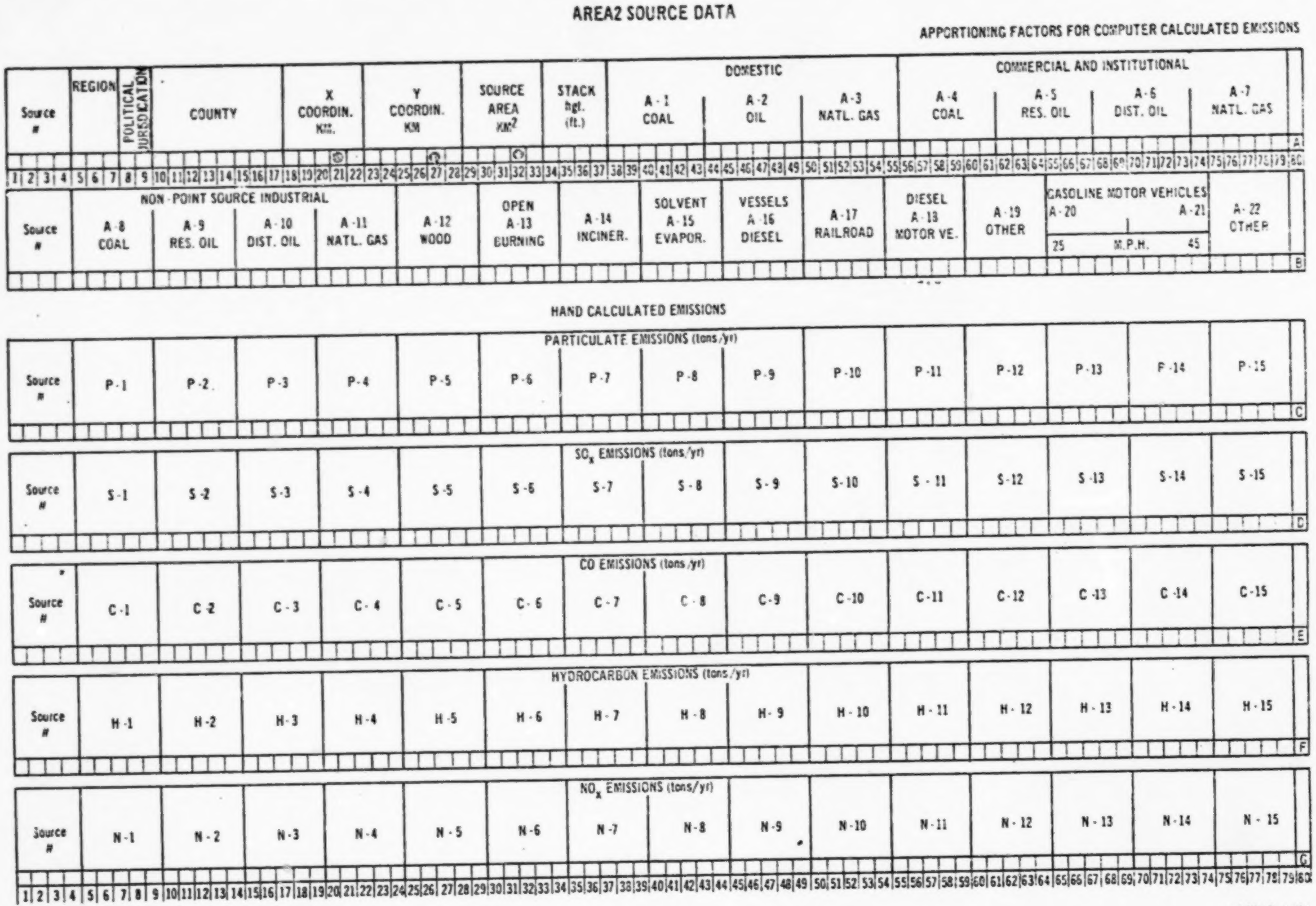
- P-1 Grain Handling
- P-2 Asphalt Batching Plants
- P-3 Aircraft emissions
- P-4 Slash burning
- P-5 Wildfires
- P-6 Agricultural burning

Table 4 - Pollutant (particulates)

- Calculated 1 - Table 1 totals for each county
- Calculated 2 - Table 2 " " " "
- Additional - Table 3 " " " "

The same format is repeated for the other pollutants:

- Sulfur dioxide
- Carbon monoxide
- Hydrocarbons
- Nitric oxides



AREA2 SOURCE DATA

APPORTIONING FACTORS FOR COMPUTER CALCULATED EMISSIONS

								DOMESTIC			COMMERCIAL AND INSTITUTIONAL				
Source #	REGION	POLITICAL JURISDICATION	COUNTY	X COORDIN. KM.	Y COORDIN. KM	SOURCE AREA KM^2	STACK hgt. (ft.)	A-1 COAL	A-2 OIL	A-3 NATL. GAS	A-4 COAL	A-5 RES. OIL	A-6 DIST. OIL	A-7 NATL. GAS	A

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

	NON-POINT SOURCE INDUSTRIAL												GASOLINE MOTOR VEHICLES			
Source #	A-8 COAL	A-9 RES. OIL	A-10 DIST. OIL	A-11 NATL. GAS	A-12 WOOD	OPEN A-13 BURNING	A-14 INCINER.	SOLVENT A-15 EVAPOR.	VESSELS A-16 DIESEL	A-17 RAILROAD	DIESEL A-18 MOTOR VE.	A-19 OTHER	A-20 25	A-21 M.P.H. 45	A-22 OTHER	B

HAND CALCULATED EMISSIONS

	PARTICULATE EMISSIONS (tons/yr)														
Source #	P-1	P-2	P-3	P-4	P-5	P-6	P-7	P-8	P-9	P-10	P-11	P-12	P-13	P-14	P-15	C

	SO$_x$ EMISSIONS (tons/yr)														
Source #	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15	D

	CO EMISSIONS (tons/yr)														
Source #	C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10	C-11	C-12	C-13	C-14	C-15	E

	HYDROCARBON EMISSIONS (tons/yr)														
Source #	H-1	H-2	H-3	H-4	H-5	H-6	H-7	H-8	H-9	H-10	H-11	H-12	H-13	H-14	H-15	F

	NO$_x$ EMISSIONS (tons/yr)														
Source #	N-1	N-2	N-3	N-4	N-5	N-6	N-7	N-8	N-9	N-10	N-11	N-12	N-13	N-14	N-15	G

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

APCO (Dur) 194
4/71

FIGURE C-2. AREA SOURCE DATA FORM

Table 5

- Total fuel for each category (A-1 to A-22)
- Total emission of each pollutant summed for each category over AQCR

Table 6-1

Apportioning factors used for fields A-1 to A-11

- 1-3 Population
- 4-7 Retail establishments

Table 6-2

Apportioning factors used for fields A-12 to A-22 (actually numbered from 1-11):

- (13) Population not served by a point-source city dump
- (15) Population
- (17) RR track mileage
- (18) Truck registration
- (19) Automobile registration
- (20) Urban automobile registration*
- (21) Rural automobile registration*

Table 6-3

Erroneously titled - Title should be "Total Fuel Apportioned".

- Fields A-1 to A-11

Table 6-4

Same, for Fields A-12 to A-22

The tables following 6-4 are detailed tabulations of emissions for each county.

---

* A county was either urban (>50%) or rural (<50%).